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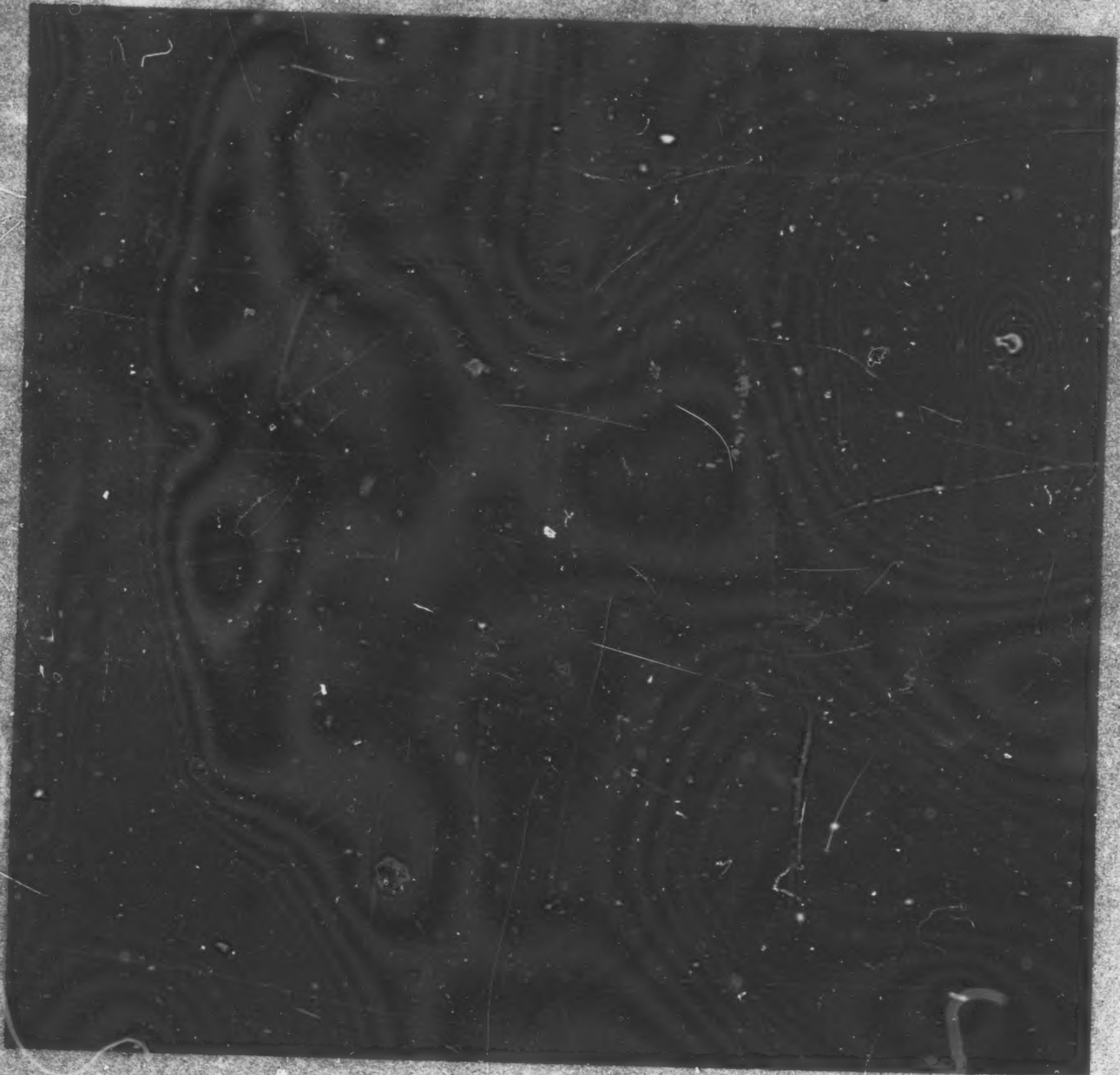
U.S. Department of Transportation
Federal Aviation Administration

National Airspace System Plan

(Serial)

ORIGINAL

Facilities, Equipment, Associated Development and Other Capital Needs



April 1987

Congressionally Requested Update
Pursuant to Sec 504(b)(1) P.L.97-248

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CHAPTER I

EXECUTIVE SUMMARY AND OVERVIEW

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EXECUTIVE SUMMARY

The National Airspace System (NAS) is the busiest and most complex in the world. It is a mixture of equipment, techniques, and skills that has evolved over 40 years. Without question, it is the world's safest and most efficient yet, at the outset of this Plan, its expansion capability was limited, and adaptability to changing requirements was difficult.

Aviation activity is forecast to increase substantially over the next two decades. Continuing growth in the number of aircraft operations, number of aircraft, enplanements, diversity of operations, and sophistication of aircraft will place unprecedented demands on the NAS. Meeting this challenge requires improved and expanded services, additional facilities and equipment, improved work force productivity, and the orderly replacement of aging equipment.

In December 1981, the Federal Aviation Administration (FAA) chartered a comprehensive NAS Plan for modernizing and improving air traffic control and airway facilities services through the year 2000.

This is the the fifth annual update of the NAS Plan. The Plan addresses the compelling problems of how best to improve safety and efficiency, accommodate spiraling demands for aviation services, deal with the problems of aging or obsolete facilities, recognize the users desires for minimal restrictions on the use of the airspace, allow for a reduced Federal role, and create a foundation for continued evolution which exploits newer technologies and developments obtained through future research. The recurring theme throughout the Plan is that the solution lies in greater use of automation, consolidations of major facilities, and application of lower cost technology.

The FAA has made substantial progress in implementing the Plan. Projects which replace obsolete equipment are complete or well underway. Growth at many locations has been accommodated by the deployment of added capabilities. Real productivity gains have been achieved.

On the horizon are those longer term evolutionary changes which will dramatically improve the air traffic control and air navigation system in terms of safety, capacity and economy. The specific improvements, required long term capabilities, and the planned system evolution essential to flight safety and economy are evolving in a measured but well-ordered and rational manner. Benefits to the taxpayers and users of the NAS are substantial and achievable.

Over the last 5 years, the user community and the Congress have supported NAS modernization. During this year, new authorizing legislation which will set the course for the continuation of that process will be reviewed by the Congress.

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OVERVIEW

INTRODUCTION

The National Airspace System, including the procedures and equipment which comprise it, has evolved over the past 40 years. Through the cooperative and dedicated efforts of the FAA personnel and the community of aviation users, this system has compiled, and continues to compile, an outstanding record of operational safety and efficiency. Prior to the 1980's, improvements in technology or innovations in procedures were implemented in a manner that principally remedied localized operational problems that already had or were expected to occur. System evolution involved a series of piecemeal adjustments and improvements. This evolution produced a mixture of equipment of varying technological generations and types. As a result, the system of 1980 was expensive to operate and maintain, expansion capability was limited, and adaptability to changing requirements was difficult.

What had been missing was a plan for evolution designed to implement National Airspace System improvements which met stated goals and objectives. The National Airspace System Plan for Facilities, Equipment and Associated Development, first issued in 1981 and revised annually per congressional request, satisfied the need to define the orderly and rational evolution of the system as a whole.

Since 1981, substantial progress has been achieved in executing the new directions which have been charted. The contents of this particular document reflect these achievements and FAA's best judgments on future actions still required to modernize the National Airspace System in accordance with previous Plans. Additionally, this document contains plans for other capital needs which have previously been unforeseen.

Modernization of the NAS is based on a total system approach which relates the needs of the user community to technical opportunities, human factors, and operational considerations. Recasting the technical framework is needed to improve safety and efficiency, accommodate spiraling demands for aviation services at constrained cost, deal with the problems of aging or obsolete facilities, recognize the user's desires for minimal restrictions on the use of the airspace, allow for a reduced Federal role, and create a foundation for continued evolution which exploits newer technologies and developments obtained through future research.

The Plan provides near-term improvements to solve immediate problems; but, equally important, these improvements are taking place as part of an orderly planned evolution On the horizon is a modern, automated, network of facilities and equipment in which the latest levels of technology available are integrated into a coordinated system for air traffic control and air navigation. The results will not only be the replacement of outdated tube-type electronic equipment with solid-state devices and the addition of more equipment to meet current and future needs for existing services. NAS modernization will assure safe and efficient transportation for all who use and depend upon the National Airspace System and provide the foundation for sustained improvement.

Planning and system design fully recognize the presence of the large number of military air traffic control facilities that provide services within the NAS to civil and military aircraft alike. Modernization efforts recognize the continued need for these military facilities and the need for efficient interaction with those of the FAA. Planning also recognizes the need for the NAS to provide a number of unique services to military aircraft and the necessity of the NAS to be responsive to national defense requirements.

The FAA believes that this Plan enables dramatic service improvement in a practical way. A significantly safer and more efficient system is being built. And the FAA is accomplishing this at affordable cost to the taxpayer.

The user community and the Congress have supported the need for modernization since enactment of the Airport and Airway Improvement Act of 1982. During the next year, new authorizing legislation will be reviewed by Congress. Congress and the Administration, with the participation of the entire aviation community, will determine the direction of NAS modernization and the level at which it will proceed.

GOALS

The central objective of this Plan is to provide for the safe and efficient use of the Nation's airspace, while minimizing constraints on its use. The operation of the system to meet this central objective must be efficient. Specific objectives include:

- Having an operating National Airspace System in place that meets the national aviation demand at the time it is required.
- Accommodating increasing demand in a way that allows airspace users to operate with a minimum of artificial constraints and with fuel efficiency.
- Reducing operational errors by 80 percent between 1984 and 1995. Techniques for more accurate classification and counting have been developed.
- Reducing risks of midair and surface traffic collisions, landing and weather-related accidents, and collisions with the ground.
- Increasing air traffic controller and flight specialist productivity by a factor of at least two by the year 2000, compared with 1980. The productivity goal in the year 2000 is 10,982 operations per position per year.
- Reducing the technical staff required to maintain and operate the modernized and expanded system by one-third by the year 2000, compared with 1980. By the year 2000, the technical staff is expected to be 7,735.
- Maintaining the overall air traffic and airway facilities maintenance cost of field operations of the National Airspace System at the 1980 level, when adjusted for inflation, excluding the capital cost of modernization. Field operations include en route and terminal air traffic control, flight service station, and field maintenance (1980 budgeted cost: $1.48 billion).

ASSUMPTIONS

During the analysis leading to the Plan, a number of premises were considered to be logical and valid assumptions. For example:

- Aviation demand will grow significantly during the next 20 years.
- Air carrier routes and services will reflect a better balance between trip frequency and cost than would be the case under a closely regulated system.
- The commuter airline industry will be affected by deregulation for several more years. Anticipated growth will require many years of adjustment before routes and schedules stabilize. The number of commuter operators is expected to decrease slightly over the period.
- The rapid growth in business use of IFR equipped general aviation will continue. Significant growth in turbopowered aircraft will result in increased operations above 12,500 feet. This growth is expected even though both fixed and variable costs of operating aircraft are increasing.
- The number of general aviation aircraft will increase.
- System limitations on any class of users' right-of-access to the system should be imposed only when no other recourse is available to ensure the common good. Any such restrictions should be removed as soon as possible and not be considered a final solution. However, to gain access to the system, individual users must comply with conditions applicable to all classes of users and essential to the safety and efficiency of the system.

- Specific equipment may be required to operate in designated airspace.

- Individual user's preferences for routes, runways, approaches, altitudes, etc., may not be honored if they will cause delays to other users or impair the safety of the system.

- No change to the system will be permitted to reduce safety or increase risk. A very high level of midair collision protection, including a back-up ground independent airborne separation device, called traffic alert and collision avoidance system (TCAS), will be available. "See-and-be-seen" operations will continue.

- Most major airports have limited expansion capability due to physical, environmental, airspace, runway, and/or landside limitations. Few new large commercial service airports are anticipated. These factors will continue to impose capacity constraints at many large and medium hub airports.

- A limited amount of additional capacity will be achieved primarily through reduction in separation standards resulting from technological advances, through refinements in ATC procedures, and through runway, terminal, and access improvements. Solution of wake vortex problems will reduce delays, but will not eliminate them entirely. National policies on noise abatement will affect all of these assumptions.

- The airspace structure demands on participants will continue at several levels. There will be airspace in which no services are available and none needed. The National Airspace Review has had positive impact on the airspace structure; and follow-on activity is, therefore, likely to affect this Plan.

- Fuel will be available. The only fuel constraint used in developing the demand forecast in this Plan is that of price.

- ATC services within the NAS will continue to be provided by a mix of civil (FAA) and military air traffic control facilities. The military approach controls, control towers and other facilities will provide service to civilian and military aircraft alike.

THE PLANNING PROCESS

This Plan is the sixth publication based on an FAA system engineering effort which began in March 1981. It is aimed at meeting FAA's commitment to safe and efficient flight.

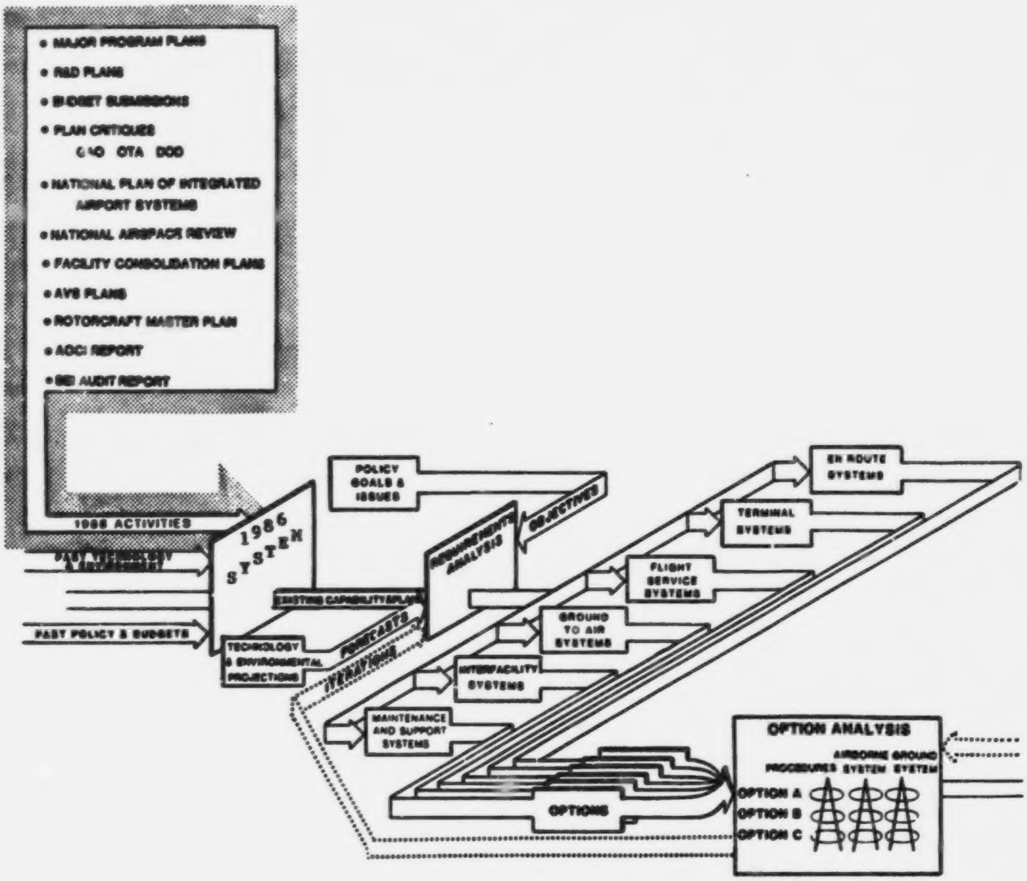
The planning process each year involves a multidisciplined team composed of representatives of most FAA organizations who participate in an iterative process of reviewing services, systems, and equipment and updating specific action plans reflecting senior management policy discussions, goals, and objectives.

The process begins with a review of current services, system capabilities, equipment, and plans along with projections of required services, future technology, and forecasts of traffic demand and mix. Options are analyzed and the Plan is updated to incorporate capabilities within the framework of the system elements which constitute the National Airspace System and are described in individual chapters of the Plan.

System elements are reviewed and evaluated against basic policy guidelines, objectives, and budgetary implications. Additionally, each system element examined serves as the basis for analysis of every other element. This leads to an iterative process of continuing reviews, ensuring that projects are consistent within each system element and between system elements, and, most important, compatible with the agency's goals. This process is depicted in the following illustrations.

Consideration is given to the necessary expansion of the system to meet anticipated future demands, provide improved safety and services, reduce operating costs, and modernize and replace aging facilities and equipment through the year 2000.

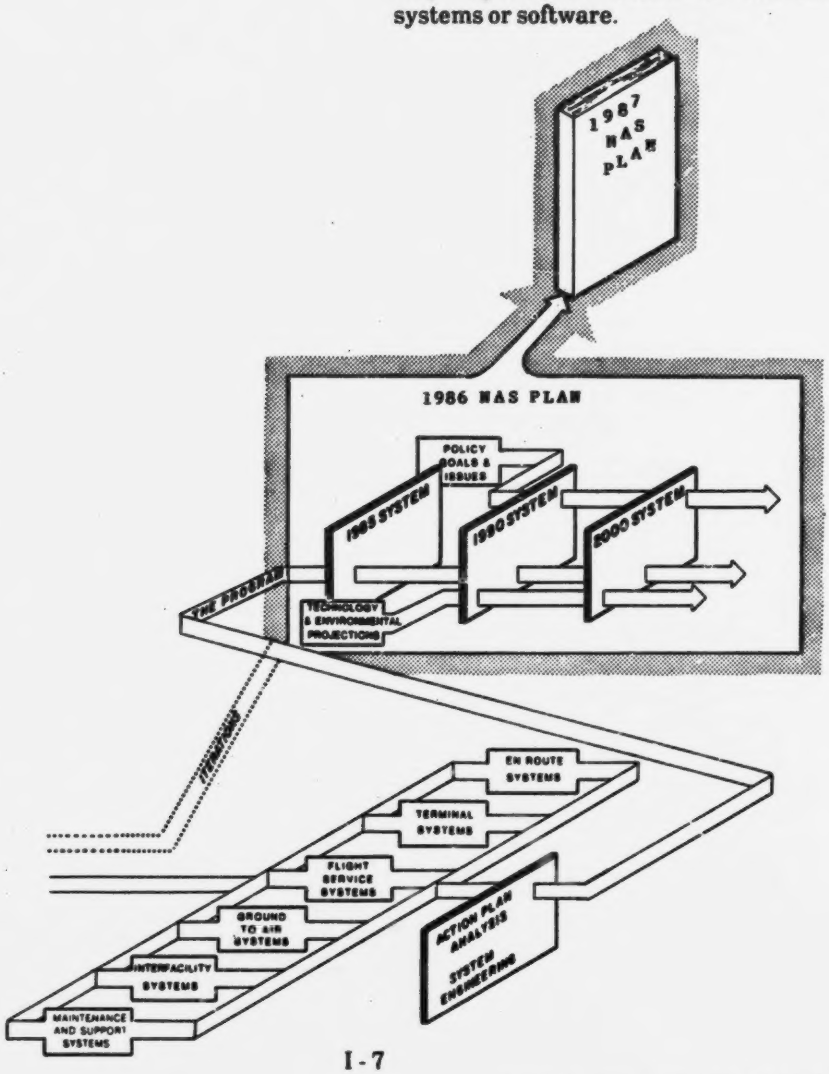
The revised Plan reflects revisions to the status of each program and incorporates the results of further planning, studies, and decisions that were made in the past year.


• MAJOR PROGRAM PLANS
• R&D PLANS
• BUDGET SUBMISSIONS
• PLAN CRITIQUES
GAO OTA DOD
• NATIONAL PLAN OF INTEGRATED AIRPORT SYSTEMS
• NATIONAL AIRSPACE REVIEW
• FACILITY CONSOLIDATION PLANS
• AVS PLANS
• ROTORCRAFT MASTER PLAN
• ADCI REPORT
• SEI AUDIT REPORT
1986 ACTIVITIES
PAST TECHNOLOGY & ENVIRONMENT
PAST POLICY & BUDGETS
1986 SYSTEM
EXISTING CAPABILITY&PLAN
TECHNOLOGY & ENVIRONMENTAL PROJECTIONS
FORECASTS
ITERATIONS
POLICY GOALS & ISSUES
OBJECTIVES
REQUIREMENTS ANALYSIS
EN ROUTE SYSTEMS
TERMINAL SYSTEMS
FLIGHT SERVICE SYSTEMS
GROUND TO AIR SYSTEMS
INTERFACILITY SYSTEMS
MAINTENANCE AND SUPPORT SYSTEMS
OPTIONS
OPTION ANALYSIS
PROCEDURES
AIRBORNE SYSTEM
GROUND SYSTEM
OPTION A
OPTION B
OPTION C

THE STRUCTURE OF THE PLAN

There are six additional chapters in this Plan. Chapter II is a compilation and discussion of information about the demand on the system. Each of the next four chapters represents a major element or portion of the National Airspace System. The last chapter contains projects designed to meet other capital needs, which have become apparent but have not been accommodated. These new projects are being added to maintain and/or improve the operation and safety of the air traffic control system.

Each chapter pertaining to a major element of the NAS contains a narrative description of the current system and its evolution through the initial effort period (1981-1985), near term (1985-1990), and long term (1990-2000). The evolution is also shown in evolution diagrams which indicate the relationships between projects and systems. The description is further illustrated by a series of maps depicting changes through each of the so-called "snapshot" years: 1981, 1985, 1990, and 2000. This is followed by short discussions, graphs, and charts indicating the effects of implementation of the Plan on operating costs and staffing. The remaining portion of each chapter provides a description of the major facilities and equipment (F&E) projects and the research and development (R&D) projects supporting these elements or leading to the acquisition of systems, equipment, or software programs. Each project description provides the purpose of the project, the approach to be taken to meet a specific need, the expected product including the quantities being acquired, and a listing of related projects. At the bottom of each project sheet are charts depicting the schedules and major milestones to be met, both for the F&E and R&D portions of the project. Some projects may be F&E acquisitions of existing technology or off-the-shelf systems that do not require R&D efforts. Others may require R&D efforts for the development of systems or software.


1987 NAS PLAN
1986 NAS PLAN
POLICY GOALS & ISSUES
1985 SYSTEM
1990 SYSTEM
2000 SYSTEM
THE PROGRAM
TECHNOLOGY & ENVIRONMENTAL PROJECTIONS
ITERATIONS
EN ROUTE SYSTEMS
TERMINAL SYSTEMS
FLIGHT SERVICE SYSTEMS
GROUND TO AIR SYSTEMS
INTERFACILITY SYSTEMS
MAINTENANCE AND SUPPORT SYSTEMS
ACTION PLAN ANALYSIS
SYSTEM ENGINEERING

SYSTEMS APPROACH TO IMPLEMENTATION

The design and implementation of the modernized National Airspace System is a major engineering task that requires a sustained comprehensive systems engineering approach to performance requirements, design specifications, and systems integration.

To respond to this need, the FAA awarded a multi-year system engineering and integration (SEI) support contract in February of 1984. Under the contract, the SEI contractor shares with FAA the mission responsibility for implementing the NAS Plan within budget and on schedule. The SEI contractor is providing program management support to the NAS Program Director, system engineering support for the design, integration and transition planning, and in-depth technical assistance to the individual managers of the NAS Plan projects.

The initial task of the SEI contract was the completion of an independent audit of the NAS Plan. The audit was conducted to verify technical validity and feasibility, system safety, user benefits, costs, and schedules. The audit found the NAS Plan to be well conceived for effecting an orderly modernization of the NAS. The plan accurately defines the needs of the system, provides approaches to remedy existing system problems, and defines methods to safely accommodate an evolutionary growth in system capacity and capability. The audit confirmed that the NAS Plan is technically feasible and within current technology, and provides the cornerstone for the NAS modernization program.

Successful completion of the NAS Plan programs requires intensive management attention and the application of disciplined system engineering and management principles. The FAA and SEI contractor have established the organization, procedures, and processes to monitor and control the technical and financial aspects of the total NAS Program. These controls include cost, schedule, risk analysis, benefits analysis, and configuration management accomplished through the use of supporting automated systems.

A master schedule system has been established. The schedule status of projects, reflected in this edition of the NAS Plan, is derived from this system.

Due to the size and complexity of the NAS modernization program, the system engineering tasks have been divided into three principal elements: functional design, allocated design, and the transition plan. The functional design was completed and baselined in October 1984. This baseline document defines the NAS architecture and provides a functional description of facilities and their interdependencies. The design allocates functions to subsystems based on operational requirements.

The allocated design quantifies the performance requirements for those subsystems contained in the functional design. This design, which is based on the quantities, locations and interconnectivity among facilities, details the performance requirements for subsystems and interfaces. Initial design reviews were completed and the NAS System Specification was issued in December 1986.

The transition plan specifies the technical requirements for fielding the hardware and software provided by individual projects. It identifies installation requirements for hardware and software and requirements for integration testing, support, and training. Initial design reviews were completed on the transition plan. A draft was submitted for FAA regional office review. Architectural and Engineering (A&E) support is provided for defining standard installation and ARTCC control wing design requirements at various regions. SEI offices have been established at the nine regional offices and the FAA Technical Center.

In conjunction with the system level design and transition planning, an integration test plan has been developed to define the system integration tasks that should be performed at the FAA Technical Center. The plan defines test configurations for laboratory resources to verify that the performance requirements have been met before systems are implemented in the field.

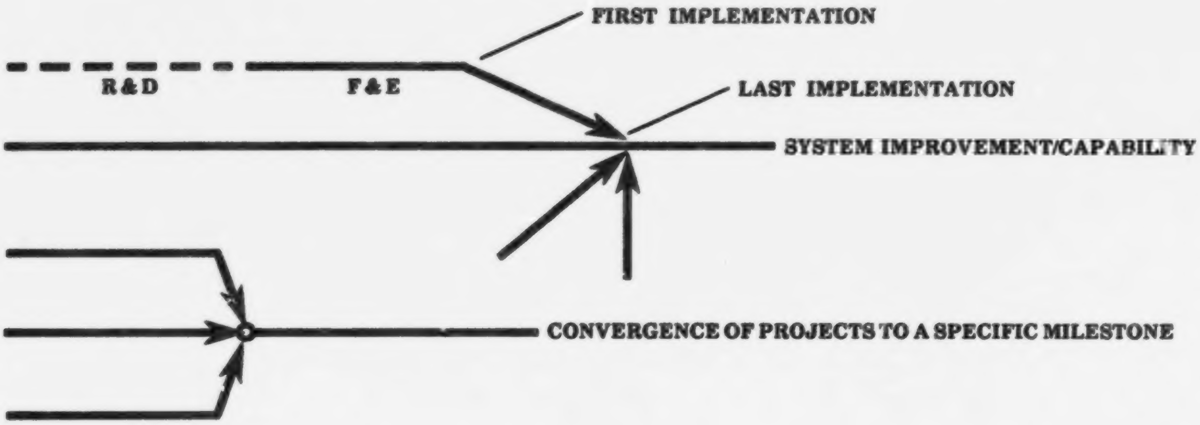
Extensive project-level technical support is also being provided by the SEI contractor. This includes independent verification and validation of software, technical assistance in subsystem specification development, and monitoring of individual development contracts.

The complexity of the NAS modernization program dictates that increased emphasis be placed on early planning for integrated logistics support to preclude the cost and schedule impact of correcting deficiencies after equipment deployment and to minimize subsystem life-cycle costs. To accomplish this goal, it is necessary that the support elements of a system/subsystem are planned early, acquired, verified, and deployed in a uniform and systematic manner. The National Airspace Integrated Logistics Support (NAILS) process will be used to identify requirements for direct work staffing, personnel skills, training programs, support equipment, maintenance facilities, transportation, handling, packaging, and other support requirements. Implementation of NAILS is governed by the NAILS Master Plan which provides specific requirements, describes tasks, and identifies responsibilities.

Configuration management and Documentation Management systems have been installed to maintain the integrity of the life-cycle and to control its orderly evolution.

LEGEND

Evolution Diagrams: Evolution diagrams are provided to illustrate project relationships in Chapter I, Executive Summary and Overview and in Chapters III through VI to illustrate project relationships toward the achievement of system improvements/capabilities.

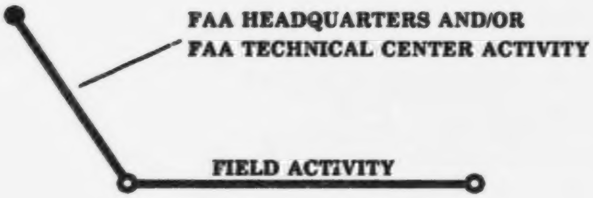

FIRST IMPLEMENTATION
R&D
F&E
LAST IMPLEMENTATION
SYSTEM IMPROVEMENT/CAPABILITY
CONVERGENCE OF PROJECTS TO A SPECIFIC MILESTONE

Project Schedules: Chapters III through VII include schedule diagrams for each specific project. These diagrams include R&D and F&E activities where appropriate. The following legend provides a guide for the reader's use when reviewing project schedules.

LEGEND:

● COMPLETED MILESTONE

○ PROJECTED MILESTONE


FAA HEADQUARTERS AND/OR
FAA TECHNICAL CENTER ACTIVITY
FIELD ACTIVITY

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HIGHLIGHTS OF THE PLAN

EN ROUTE AND TERMINAL ATC

With regard to en route and terminal systems, the Plan has three principal thrusts:

- Major facilities will be consolidated from more than 200 today to less than 30 by the year 2000.
- Common modular computers, software, and controller work stations (i.e., sector suites) will increase capacity and availability.
- Higher levels of automation will improve safety, fuel efficiency, and productivity.

En route and terminal facilities will be consolidated into area control facilities (ACF) with most hardware and software elements identical. The central computers and sector suites used will be identical at all ACFs.

Within each ACF, the advanced automation system (AAS) will have computer processing divided between common processing equipment and the individual sector suite. Sector suites will provide a new environment in which air traffic controllers function more effectively. In a typical sector suite, multiple displays will provide a plan view of the air traffic and weather situation; alphanumeric flight and weather data and other aeronautical information, such as notices to airmen; and traffic planning data including the ability to probe the system for conflict-free, fuel-efficient flight paths. Sector suite processing capability and the designed reduced capability and emergency modes of the AAS will ensure that required surveillance, flight data, and weather information are available at the particular controller position.

Distributed processing will inherently provide high availability and protection from total system failure. Increased operational flexibility can be achieved since the number of controller operating positions can be reconfigured to meet changing demand based on day-to-day or hour-to-hour workload requirements. When traffic decreases, sector suites and associated communications can be configured into larger operating sectors; and the total number of operating positions and associated staffing can be reduced.

The advanced functions of automated en route air traffic control (AERA) will be added in incremental steps. Direct fuel-efficient route planning, flow planning, and traffic management will be added before strategic planning and full tactical clearance generation. During the period of the Plan, computer-generated clearance messages, weather, and flight information will be transmitted directly to aircraft via data link.

CONSOLIDATION AND STANDARDIZATION

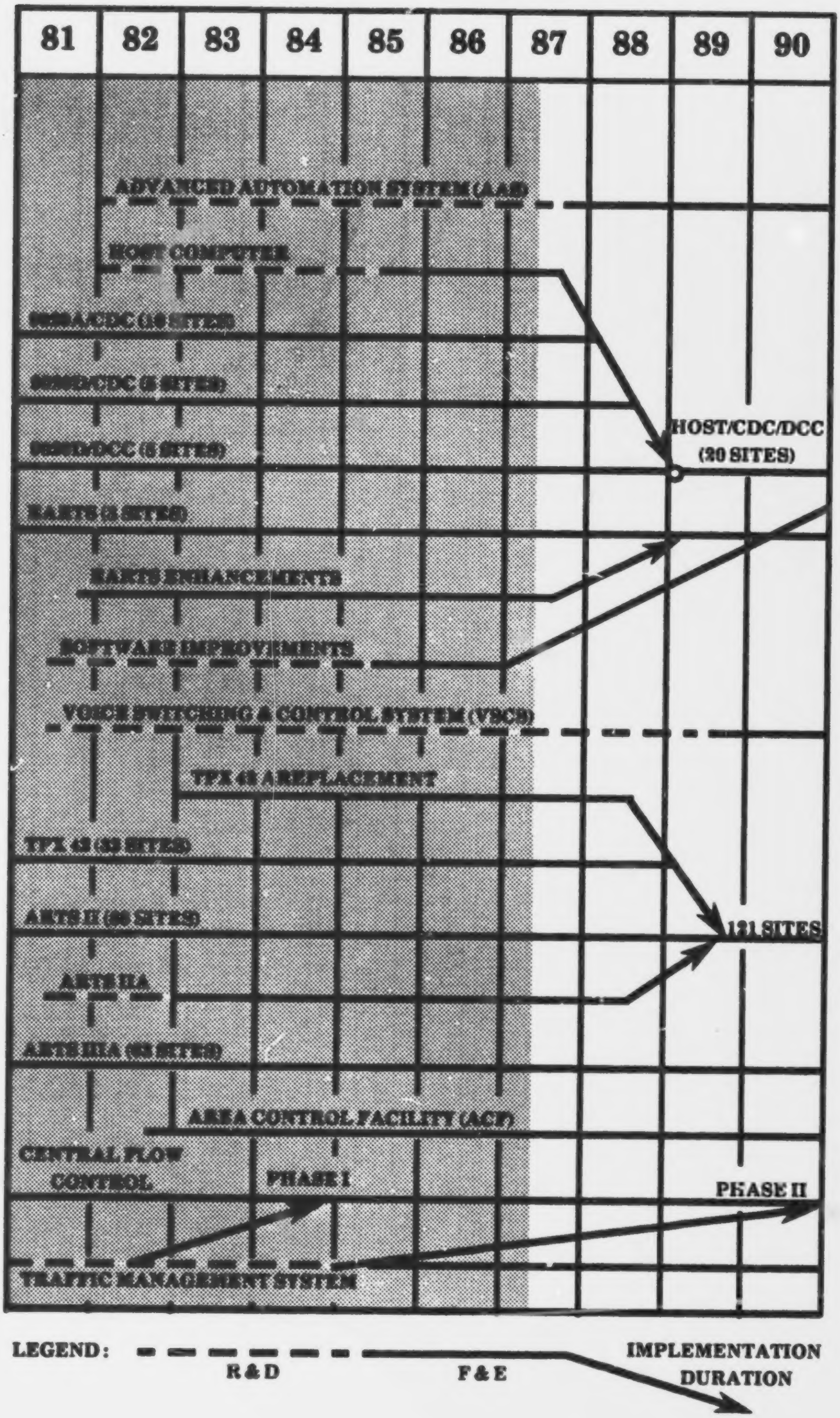
Substantial productivity gains and reduced costs will be realized through consolidation. By the year 2000 en route and terminal functions will be consolidated into area control facilities. The consolidation will transform all en route centers and 188 terminal facilities into less than 30 major air traffic control facilities by the turn of the century. Supporting airport traffic control towers will remain in place and will be supported by advanced processing and display capabilities.

System standardization will establish a family of FAA automation, display, and communication systems that provide a wide range of benefits and cost reductions. Systems standardization reduces life-cycle costs due to common operations and maintenance techniques, common engineering and staff support, lower investment in development and procurement, and common logistics and training support.

ACCOMPLISHMENTS

- AAS system preliminary design review completed.
- Host computer delivered to first operational site.
- FDIO system installed in 160 sites.
- EARTS enhancements delivered to first operational site.
- AERA 2 functional specification completed.
- VSCS prototype system contract awarded.
- En Route Automation Hardware Improvements Project completed.
- CA/MCI installed at Fort Worth ARTCC.
- E-DARC system implementation at first operational site completed.

- ODAPS critical design review completed.
- TMS system specification approved.
- ARTS IIIA Assembler completed.
- Digital BRITE contract awarded.
- TPX 42 replacement contract awarded.
- ARTS IIA Enhancements contract awarded.
- Sustain the New York TRACON contract awarded.
- ARTS II displays installed.
- ARTS IIIA memory implementation completed.
- Enhanced Terminal Conflict Alert implementation begun.
- Additional ARTS IIIA support at the FAA Technical Center completed.
- ARTS II Interfacility Interface completed.
- ARTS II Interface with MODE S/ASR 9 prototype completed and production contract awarded.
- 10/20 Channel Recorders implementation begun.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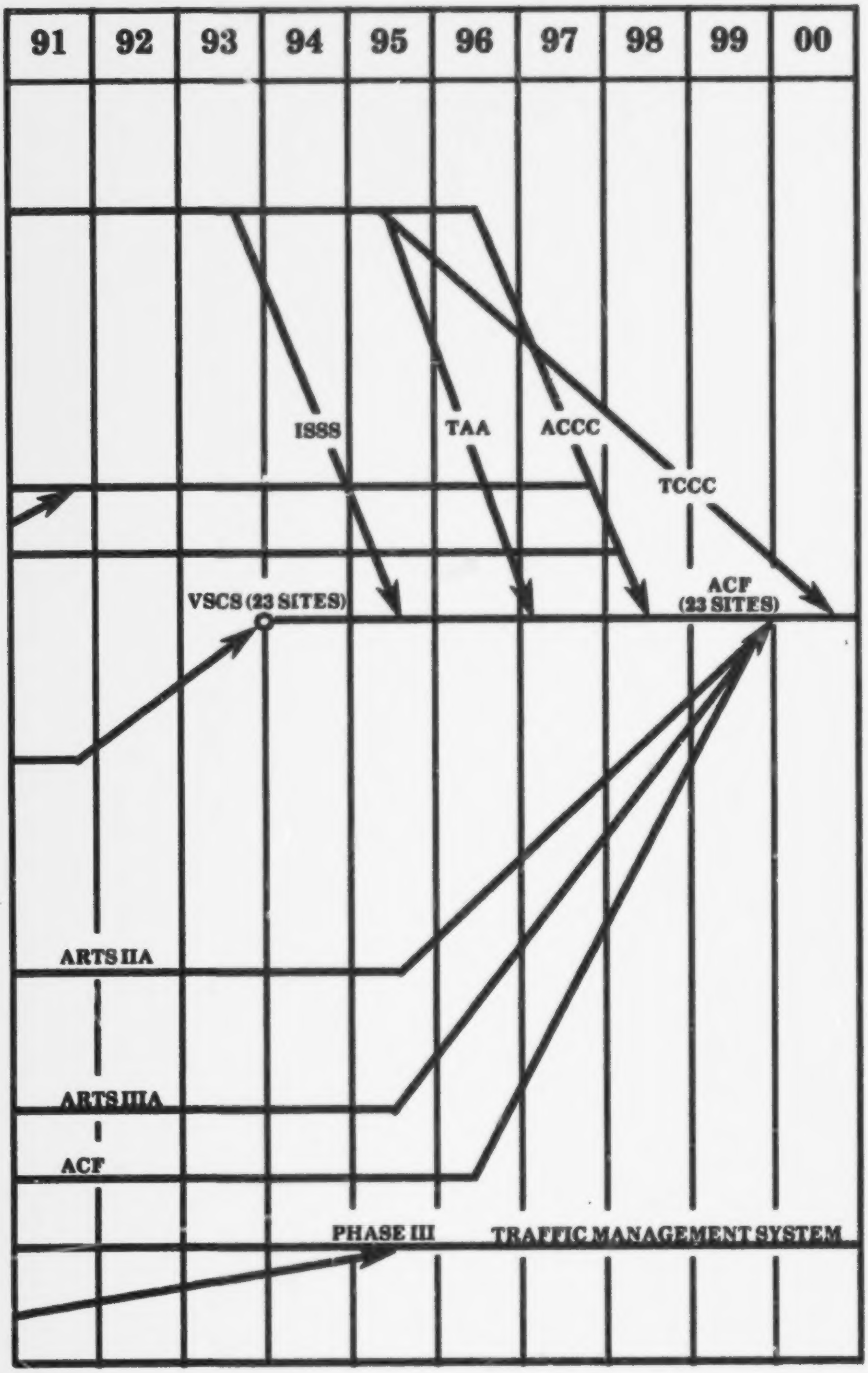
ADVANCED AUTOMATION SYSTEM (AAS)
HOST COMPUTER
9020A/CDC (10 SITES)
9020D/CDC (5 SITES)
9020D/DCC (5 SITES)
HOST/CDC/DCC
(20 SITES)
EARTS (5 SITES)
EARTS ENHANCEMENTS
SOFTWARE IMPROVEMENTS
VOICE SWITCHING & CONTROL SYSTEM (VSCS)
TPX 42 AREPLACEMENT
TPX 42 (33 SITES)
ARTS II (88 SITES)
121 SITES
ARTS IIA
ARTS IIIA (63 SITES)
AREA CONTROL FACILITY (ACF)
CENTRAL FLOW
CONTROL
PHASE I
PHASE II
TRAFFIC MANAGEMENT SYSTEM
LEGEND:
R & D
F & E
IMPLEMENTATION
DURATION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ISSS
TAA
ACCC
TCCC
VSCS (23 SITES)
ACF (23 SITES)
ARTS IIA
ARTS IIIA
ACF
PHASE III
TRAFFIC MANAGEMENT SYSTEM

EN ROUTE AND TERMINAL ATC SYSTEMS EVOLUTION

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FLIGHT SERVICES AND WEATHER

Flight service systems include flight service stations and aviation-related weather systems.

In summary, the Plan makes the following three points regarding flight services and aviation weather.

- Automation and consolidation will allow better, more complete services while constraining costs.
- Direct automated pilot access will provide "one-stop" service for weather, flight plan filing, and information about system status (delays, outages, etc.).
- Greatly improved aviation weather services will increase safety and be tailored to meet individual needs.

The system by the year 2000 will have the capability to provide the majority of flight services directly to pilots without specialists intervention. The system will also provide weather data base access to specialists on an interactive basis.

An enhanced weather position operated by a meteorologist will be located in each area control facility. Aviation weather collection, processing, and dissemination will be improved. The intent is to provide current aviation weather information throughout the National Airspace System for pilots, center and tower controllers, flight service specialists and traffic management personnel.

Automatically composed, routine en route and terminal weather will be broadcast to pilots over a national VOR network with coverage down to 2,000 feet above the terrain.

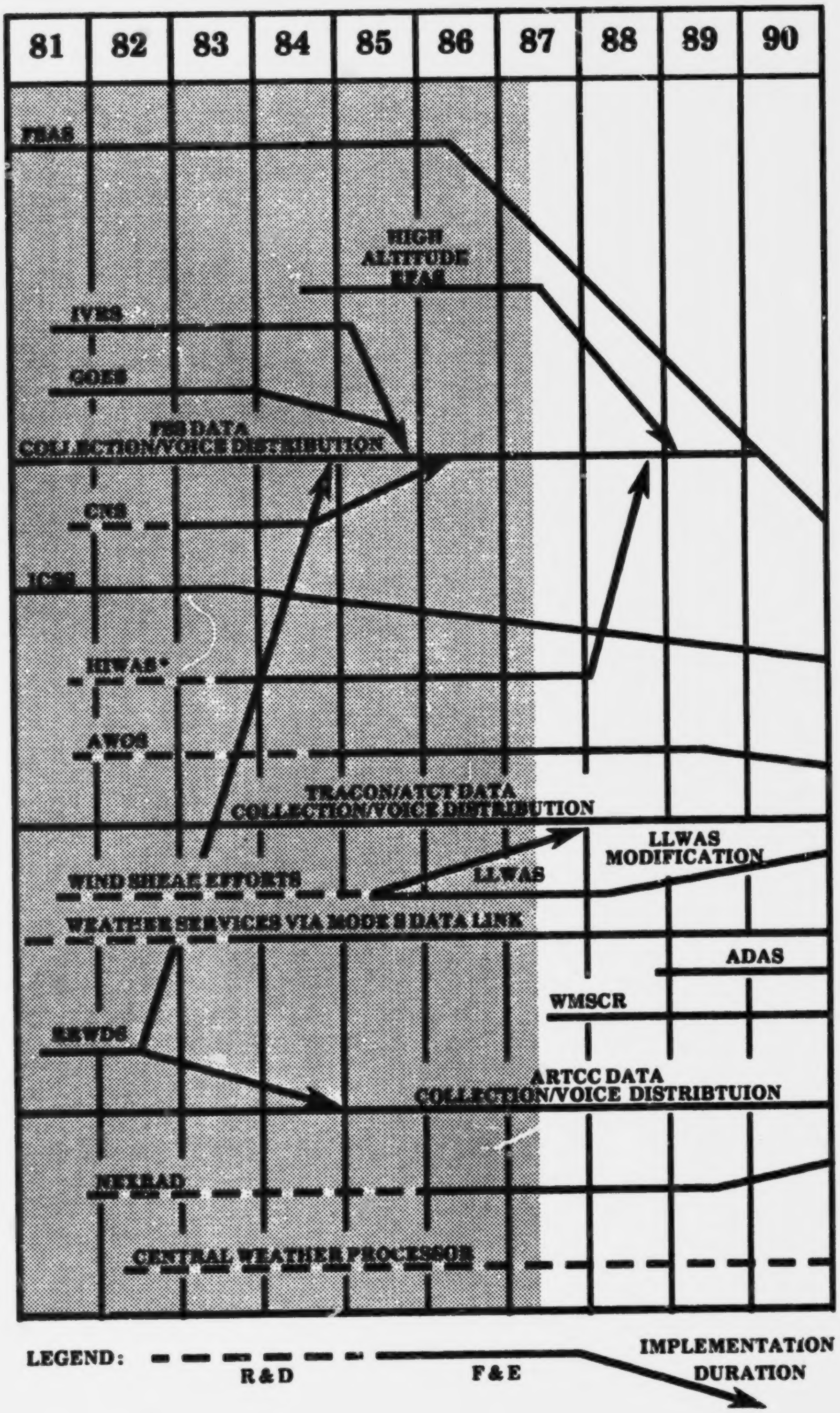
Automated weather information will be available via data link to pilots down to 12,500 feet mean sea level and at designated terminal areas by 1993. Coverage will be extended down to 6,000 feet mean sea level by the year 1995. Request/reply will be provided as well as the transmittal of significant meteorological reports.

CONSOLIDATION

By 1994, more than 300 nonautomated FSSs will be absorbed into 61 new automated facilities that provide improved service and maintenance and support costs in 1981 dollars decreased.

ACCOMPLISHMENTS

- 60 AFSS locations selected.
- 24 FSAS Model 1 systems commissioned along with 13 FSDPSs. All Model 1 equipment delivered.
- IVRS became operational.
- International and domestic CNS operational.
- HIWAS test completed and contract awarded.
- EFAS outlets contract awarded.
- AWOS pilot program and demonstration complete.
- LLWAS basic deliveries over 75 percent complete. Contract awarded for 6 sensor improvements.
- GOES project completed.
- RRWDS completed.
- CWP prototype system started.
- WMSCR specification and purchase request approved.
- WCP specification baselined.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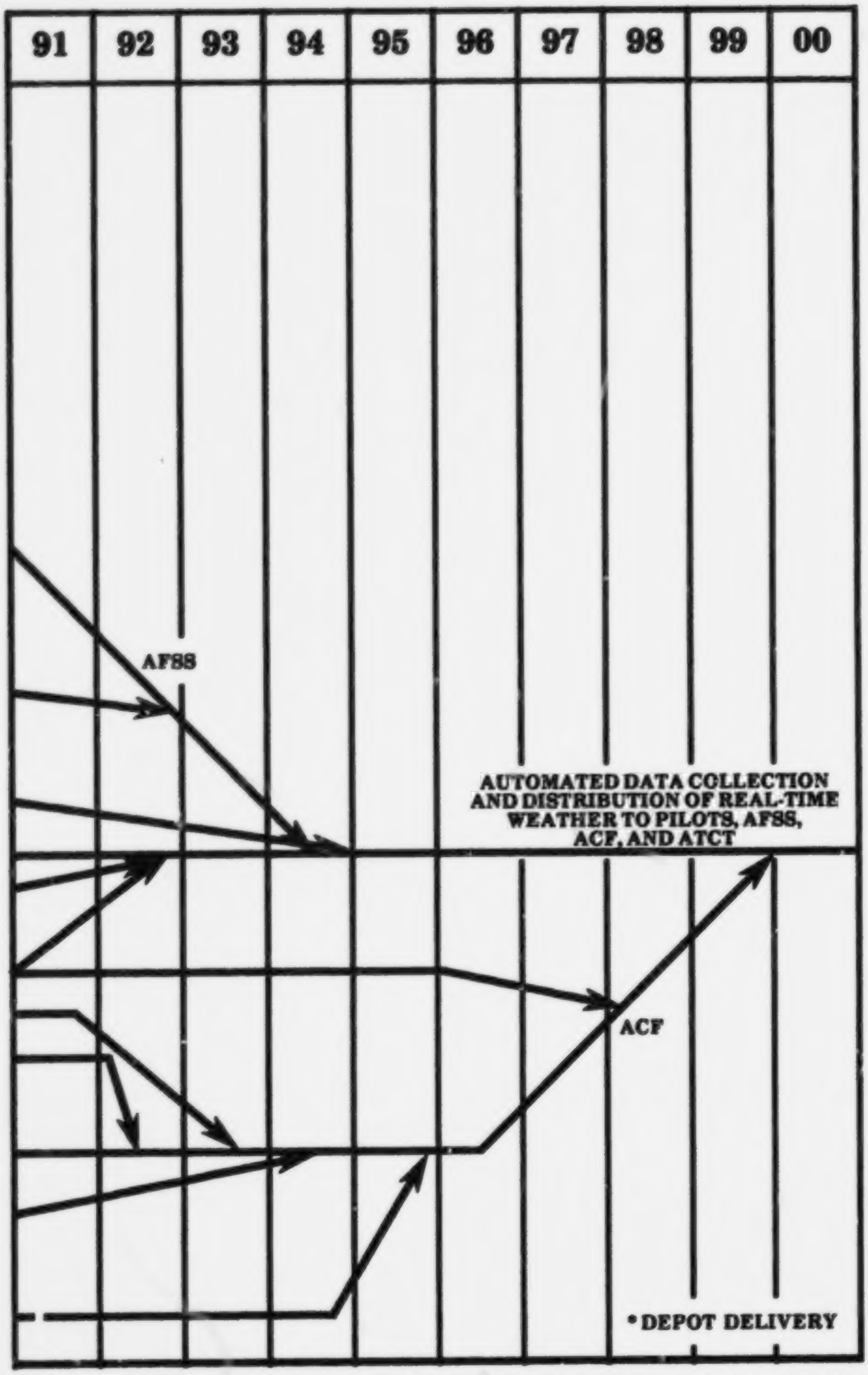
FSAS
HIGH ALTITUDE EFAS
IVRS
GOES
FSS DATA COLLECTION/VOICE DISTRIBUTION
CNS
ICSS
HIWAS*
AWOS
TRACON/ATCT DATA COLLECTION/VOICE DISTRIBUTION
WIND SHEAR EFFORTS
LLWAS
LLWAS MODIFICATION
WEATHER SERVICES VIA MODE S DATA LINK
ADAS
WMSCR
RRWDS
ARTCC DATA COLLECTION/VOICE DISTRIBTUION
NEXRAD
CENTRAL WEATHER PROCESSOR
LEGEND:
R&D
F&E
IMPLEMENTATION DURATION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AFSS
AUTOMATED DATA COLLECTION AND DISTRIBUTION OF REAL-TIME WEATHER TO PILOTS, AFSS, ACF, AND ATCT
ACF
* DEPOT DELIVERY

FLIGHT SERVICE AND WEATHER SYSTEMS EVOLUTION

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GROUND-TO-AIR

Ground-to-air systems include equipment which provides surveillance, communications, navigation, and landing-aid services.

The Plan underscores three major themes related to the ground-to-air system:

- Consolidation and modernization of navigation, radar, and communications facilities will lead to the establishment of integrated national networks providing required coverage with a reduced number of separate facilities and at reduced cost in 1981 dollars.
- Microwave landing systems (MLS) will replace instrument landing systems (ILS) and provide multiple, curved, and segmented approaches and selectable glide angles.
- A discretely addressable surveillance capability (Mode S) with an integral data link will replace the present ATC radar beacon interrogator systems at most terminal and en route surveillance sites.

The ground-to-air system, based on a networking concept, will provide nationwide service and coverage for surveillance, navigation, and voice and data link communications. Adequate coverage will be assured and additional navigation and surveillance provided as traffic demands warrant.

En route surveillance coverage, as traffic density requires, will be provided down to 6,000 feet msl or minimum instrument flight rules altitude (whichever is higher) and to the surface of qualifying airports. The network is comprised of solid-state en route and terminal search and beacon systems. Department of Defense requirements at joint surveillance sites will be met by using a national perimeter of new three-dimensional minimally attended radar systems.

Search radar will be retained for FAA weather and air traffic control requirements through the 1990's. Weather detection provided by en route search radar will gradually be replaced by the next generation weather radar (NEXRAD).

By 1993, Mode S and data link coverage will be provided down to 12,500 feet msl and to the surface at designated airports. Mode S and data link coverage by the year 1995 will be extended down to 6,000 feet msl.

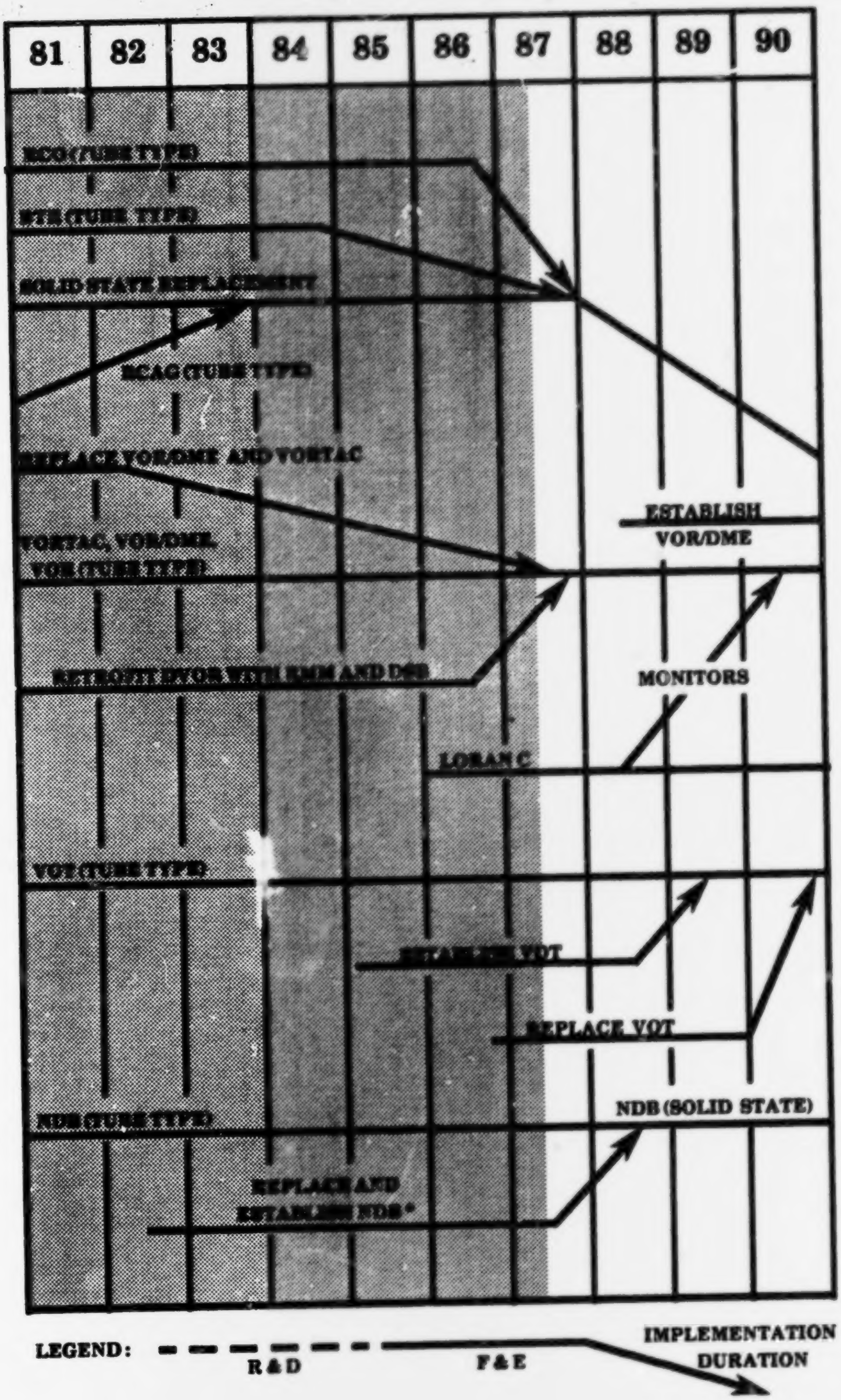
En route navigation will be provided down to 2,000 feet above terrain. Existing very high frequency omnidirectional ranges (VOR), VORs co-located with tactical air navigation (VORTAC), and VOR/distance measuring equipment (DME) will be solid state. The direction finder sensor network will be expanded to provide additional emergency assistance to pilots. Nondirectional beacons (H and HH facilities) will be added in a limited number for new navigation qualifiers only.

Solid-state ILS components will be installed to meet maintainability requirements. FAA MLS implementation will begin in 1988 and continue until 1,250 systems are installed.

En route and flight service station (FSS) voice communications coverage will be provided down to 2,000 feet above terrain. Terminal voice communications will be provided to the surface at designated airports. Existing and future radio-frequency requirements will make conversion of ground and airborne systems to 25 kHz spacing necessary.

ACCOMPLISHMENTS

- NEXRAD specification completed.
- ARSR tube-type upgrade awarded.
- ASR 9 contract awarded.
- Mode S contract awarded and first implementation imminent.
- VORTAC, VOT, A/G communications, ILS component replacement and communication consolidation being implemented.
- MLS contract awarded.
- ASDE contract awarded.
- TDWR trade studies completed.
- Electromagnetic campatibility (EMC) studies conducted and EMC guidelines developed for consolidated sites.
- PAPI and Radio Control Retrofit equipment deliveries are imminent.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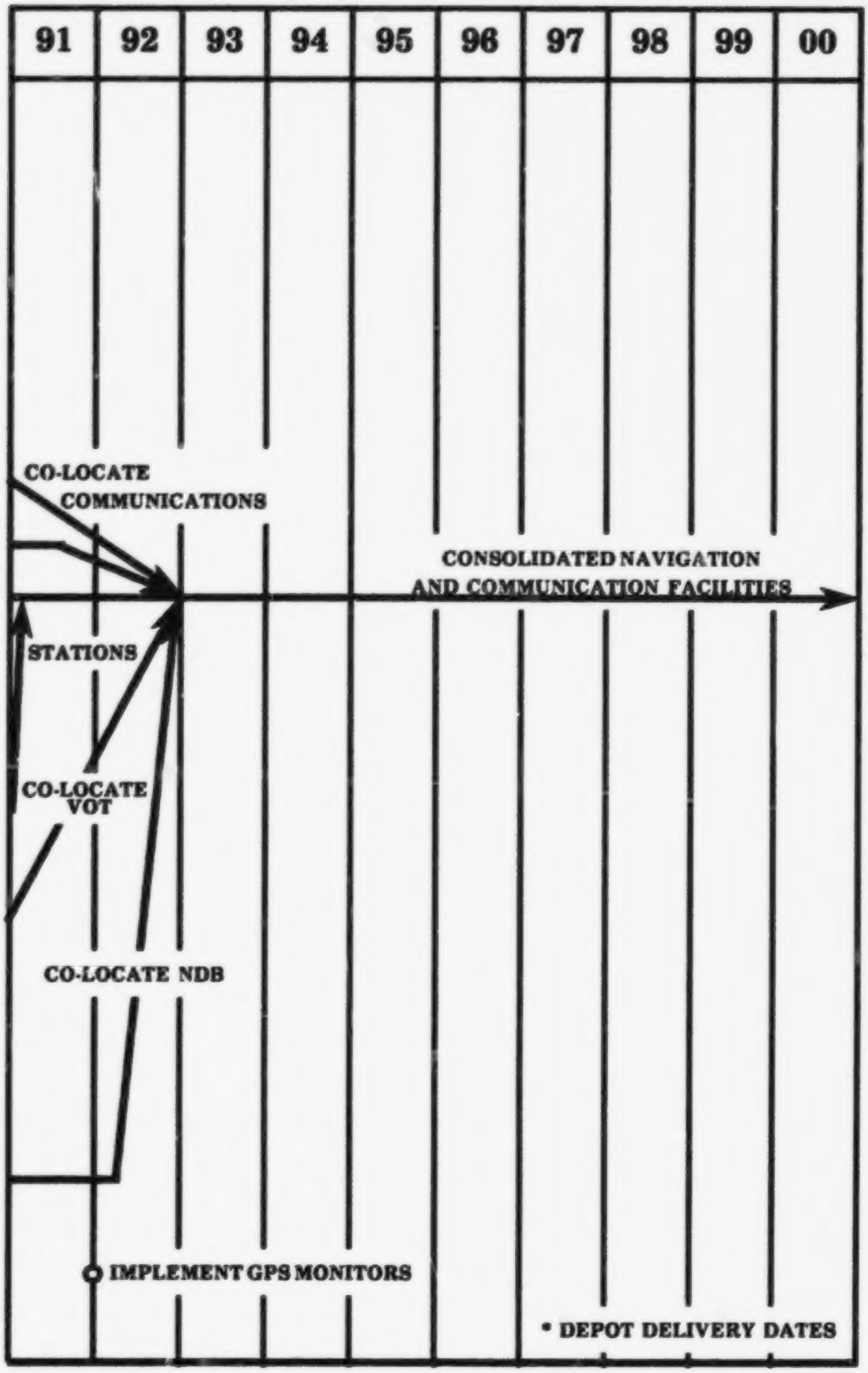
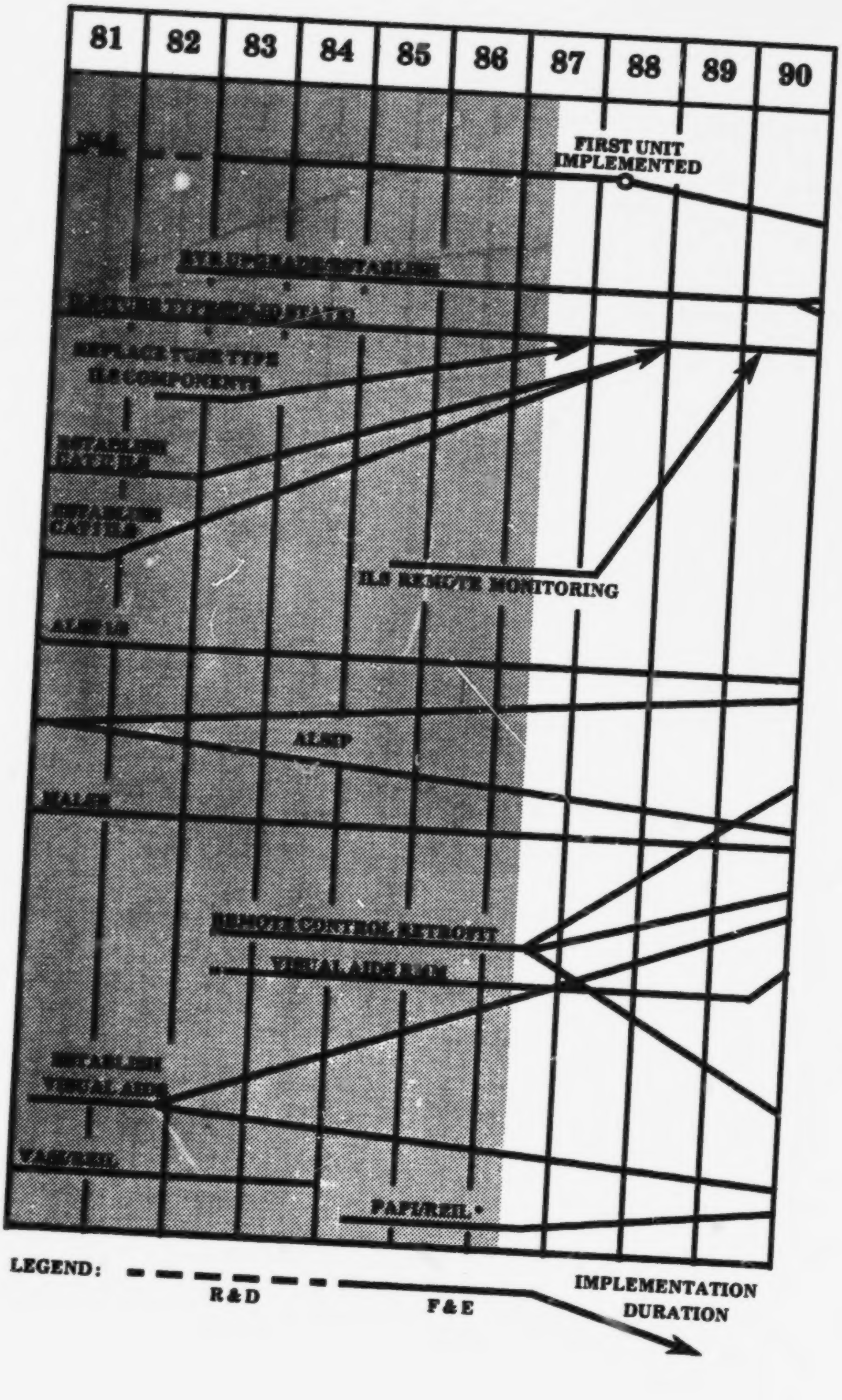
RCO (TUBE TYPE)
RTR (TUBE TYPE)
SOLID STATE REPLACEMENT
RCAG (TUBE TYPE)
REPLACE VOR/DME AND VORTAC
ESTABLISH VOR/DME
VORTAC, VOR/DME, VOR (TUBE TYPE)
RETROFIT DVOR WITH RMM AND DSB
MONITORS
LORAN C
VOT (TUBE TYPE)
ESTABLISH VOT
REPLACE VOT
NDB (SOLID STATE)
NDB (TUBE TYPE)
REPLACE AND ESTABLISH NDB *
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



NAVIGATION AND COMMUNICATIONS SYSTEM EVOLUTION



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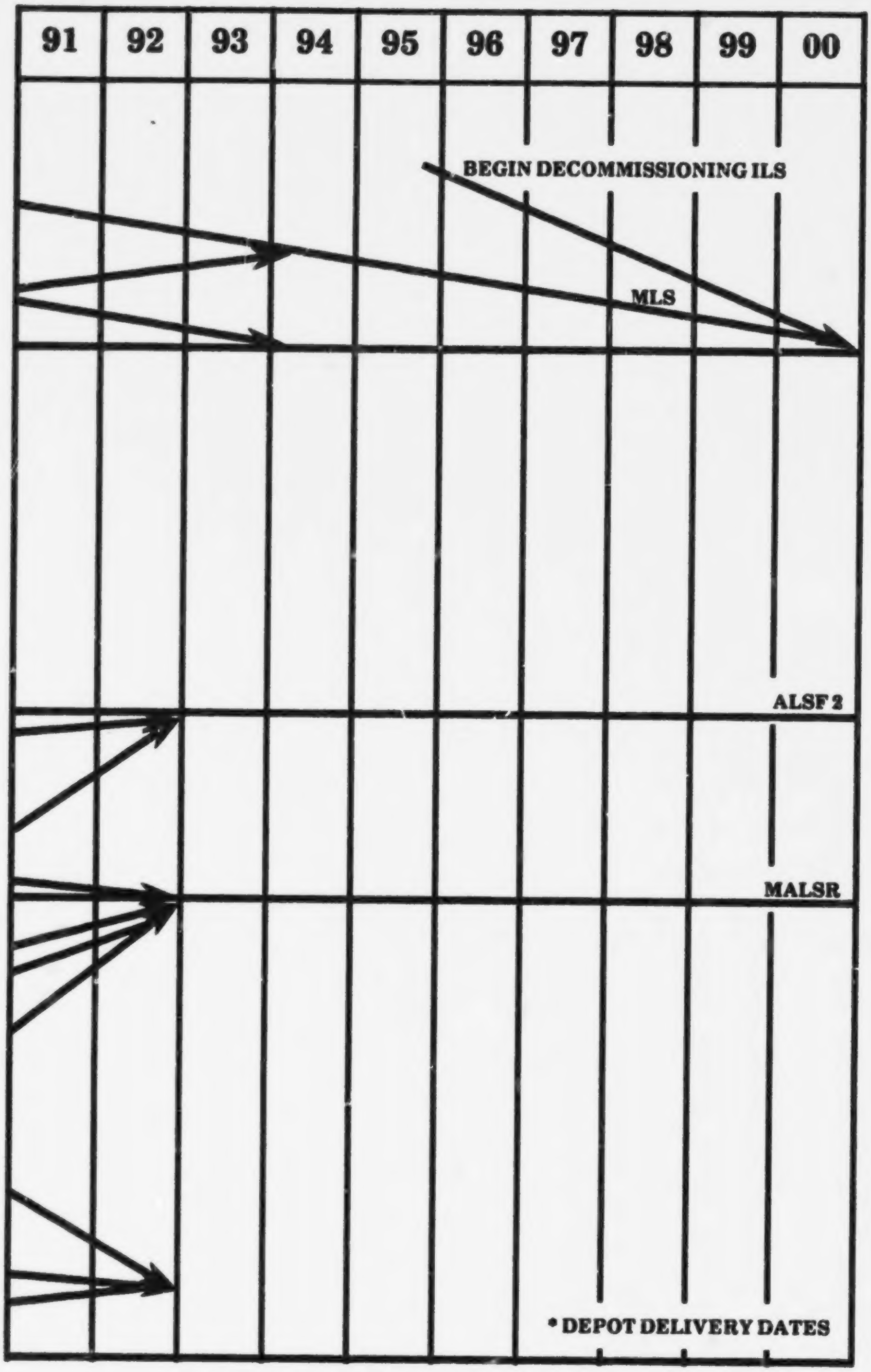
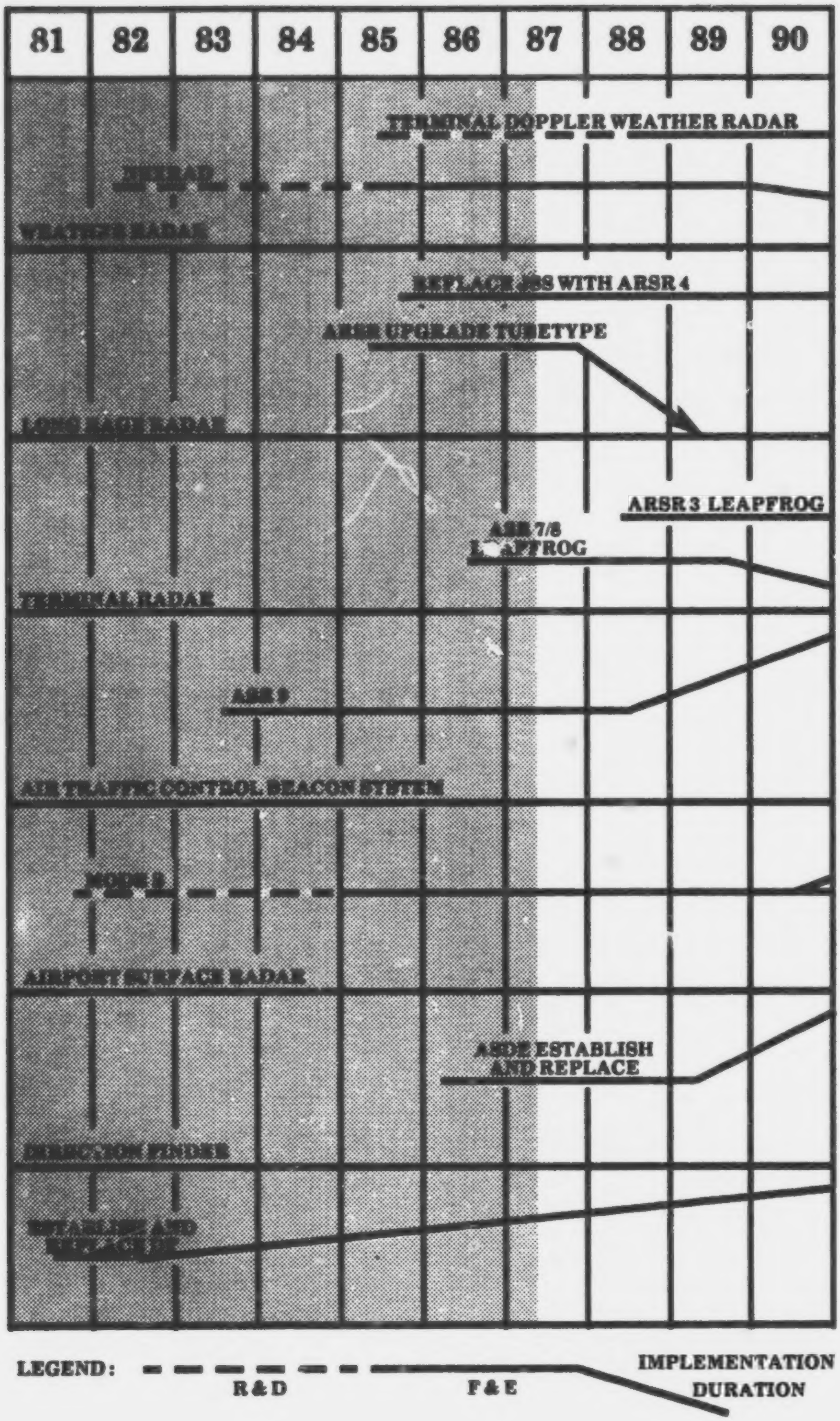


LANDING SYSTEMS EVOLUTION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TERMINAL DOPPLER WEATHER RADAR
NEXRAD
WEATHER RADAR
REPLACE JSS WITH ARSR 4
ARSR UPGRADE TUBETYPE
LONG RANGE RADAR
ARSR 3 LEAPFROG
ASR 7/8
LEAPFROG
TERMINAL RADAR
ASR 9
AIR TRAFFIC CONTROL BEACON SYSTEM
MODE S
AIRPORT SURFACE RADAR
ASDE ESTABLISH
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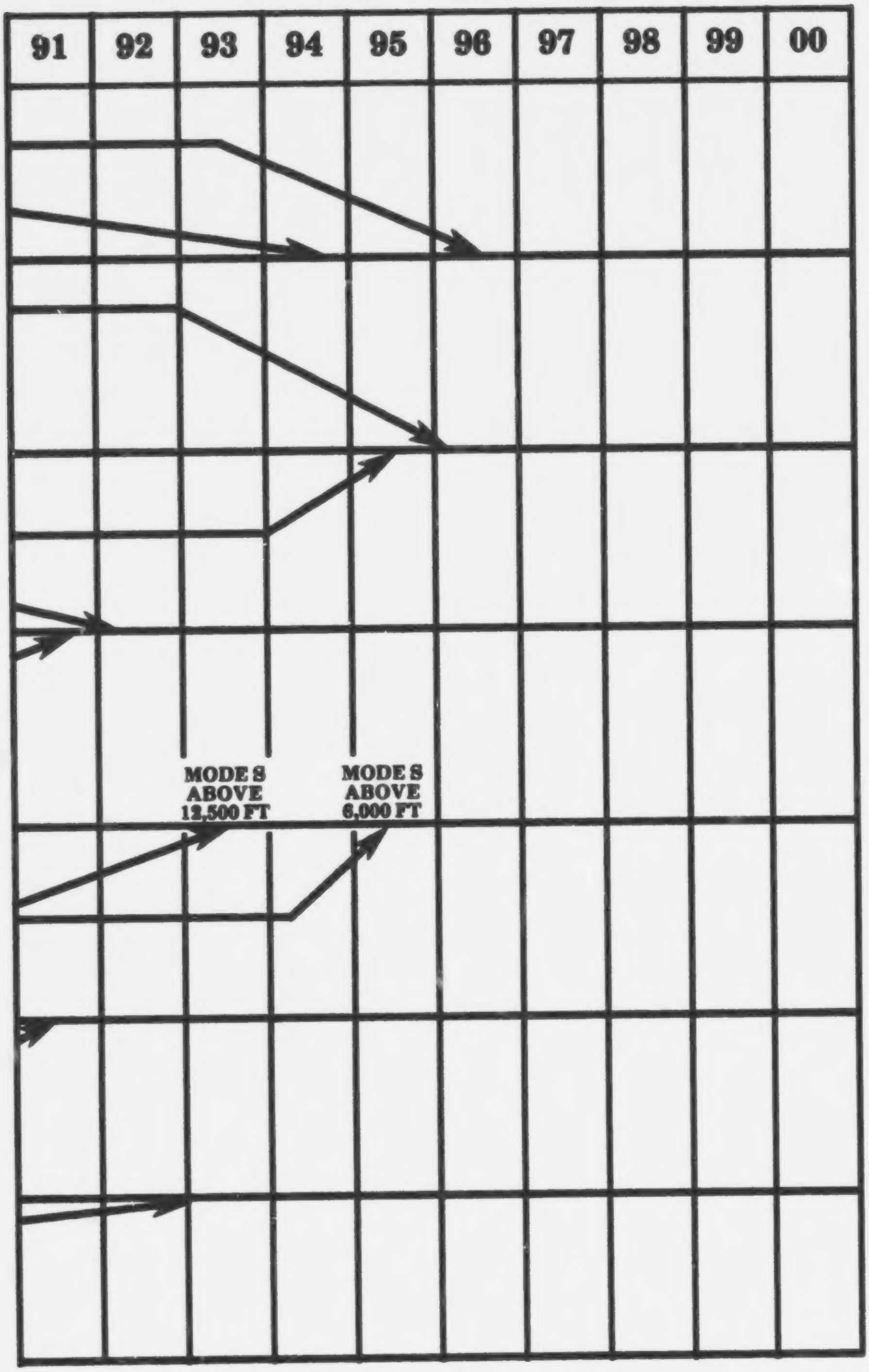

SURVEILLANCE SYSTEMS EVOLUTION

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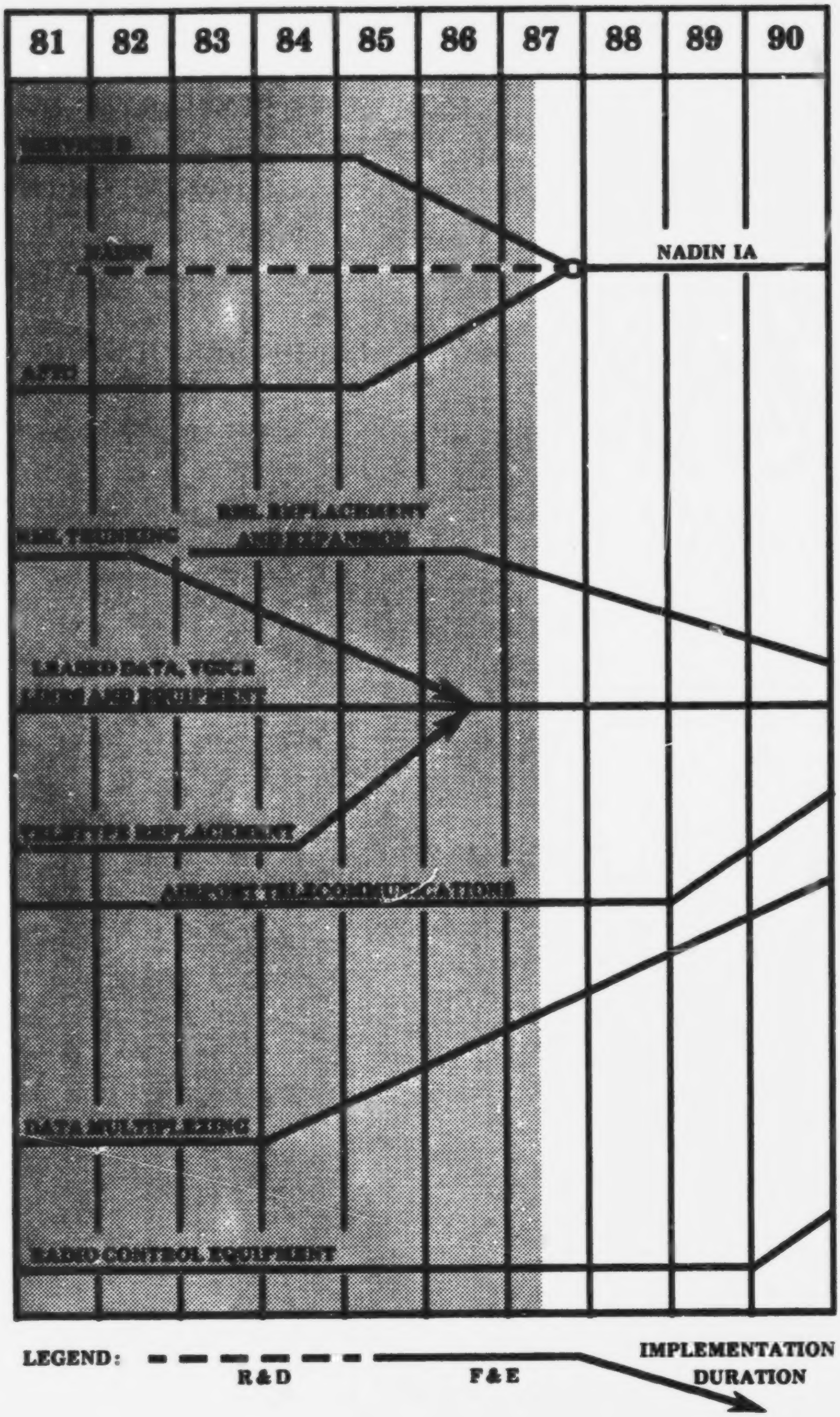
INTERFACILITY COMMUNICATIONS

The key points in the Plan relating to interfacility communications are:

- The system will be characterized by a reliable, efficient, integrated interfacility network. The network will use current-technology equipment, multiplexing, automatic switching, alternate routing, high-speed digital transfer, and trunking.
- The total network will provide a communication system at significantly lower operating costs.
- There will be a mix of owned and leased switching and carrier facilities.
- Both terrestrial and satellite carrier facilities will be used.
- Existing microwave links will be replaced with highly reliable, low-maintenance equipment.

ACCOMPLISHMENTS

- NADIN IA concentrators installed; switching center testing complete; system cutover is underway.
- RML trunking complete.
- Data multiplexing Phase I implementation complete; Phase II implementation begun.
- RML replacement contract awarded and initial implementation begun.
- Teletypewriter replacement complete.
- RCE production contract awarded.
- Fiber optic and RF link tests for airport telecommunications completed.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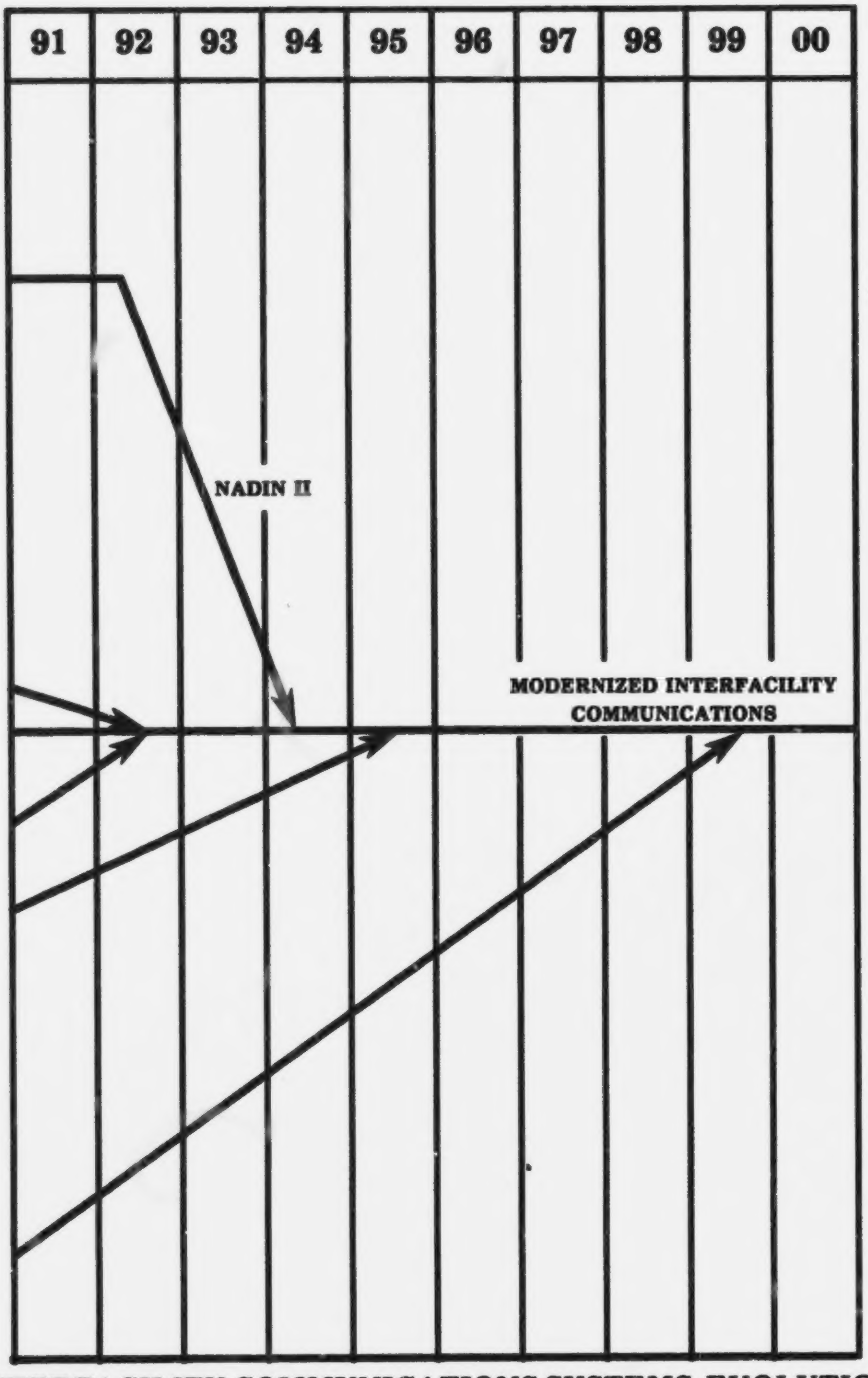
SERVICE B
NADIN
NADIN IA
AFTN
RML REPLACEMENT AND EXPANSION
RML TRUNKING
LEASED DATA, VOICE LINES AND EQUIPMENT
TELETYPE REPLACEMENT
AIRPORT TELECOMMUNICATIONS
DATA MULTIPLEXING
RADIO CONTROL EQUIPMENT
LEGEND:
R&D
F&E
IMPLEMENTATION DURATION



INTERFACILITY COMMUNICATIONS SYSTEMS EVOLUTION

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MAINTENANCE AND OPERATIONS SUPPORT

Maintenance and operations support includes the equipment, processes, and services required to support the operations of the National Airspace System. Modernization efforts encompass flight inspection, facility maintenance, power systems, and plant facilities.

National Airspace System maintenance costs, in 1981 dollars, will be substantially reduced through:

- Consolidation of work centers and manned facilities.
- Lower staffing levels made possible by remote maintenance monitoring.
- Lower support costs for FAA-owned housing and plant facilities.
- Improved field training via computer-based instruction.

Flight inspection expenditures will be contained through:

- Reductions in the number of flight inspection field offices. Consolidation has occurred.
- Modernization of the FAA aircraft fleet and flight inspection capabilities.

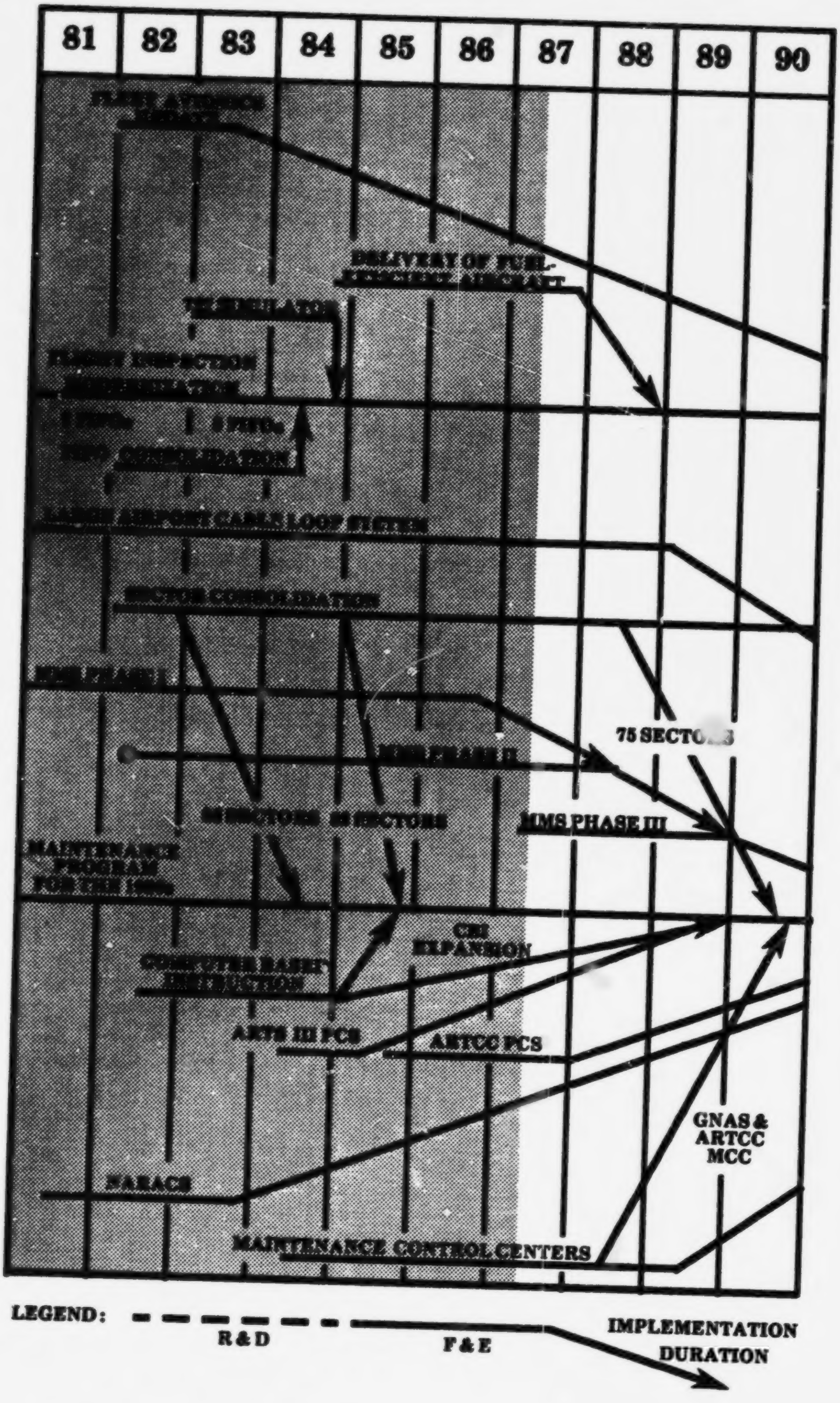
The objective is to provide improved services at less operational costs by modernizing the flight inspection program and by implementing the Maintenance Program for the 1980s.

The following is representative of these programs:

- The flight inspection modernization program replaces the current aircraft fleet with fuel-efficient aircraft, provides an automated flight inspection system, upgrades associated services, and improves the process.
- The Maintenance Program for the 1980s is a significant commitment to modify maintenance practices and consolidate the location of work stations, thereby, reducing staffing requirements.
- Existing labor-intensive vacuum-tube systems will be replaced by highly reliable, cost-effective, low-maintenance, solid-state systems.
- Modernization of facilities will provide significant energy savings.
- Labor-intensive smaller engine generators will be replaced by battery backup systems as a result of solid-state implementation.
- The above improvements will eliminate the need for costly government housing and support services at certain remote areas.

ACCOMPLISHMENTS

- AF sectors have been reduced from 115 to 81.
- MPSs have been purchased (33) and installed.
- GNAS MCC and ARTCC MCC prototypes have been established.
- VOR/VORTAC equipped with RMM have been installed (95 percent).
- ARTS III PCS contract awarded. Field installation is underway.
- FIFOs have been consolidated (seven to five).
- Portable flight inspection systems are in use.
- NARACS backbone is complete and contract awarded for Eastern and Western networks.
- System engineering and integration contractor is on board and providing support for implementation of the NAS Plan.
- Action underway to provide 3-level weather data on ARTCC controller displays.
- Heliport established in support of the General Support Laboratory at the FAA Technical Center.
- Contract for purchase of 19 turboprop aircraft awarded.



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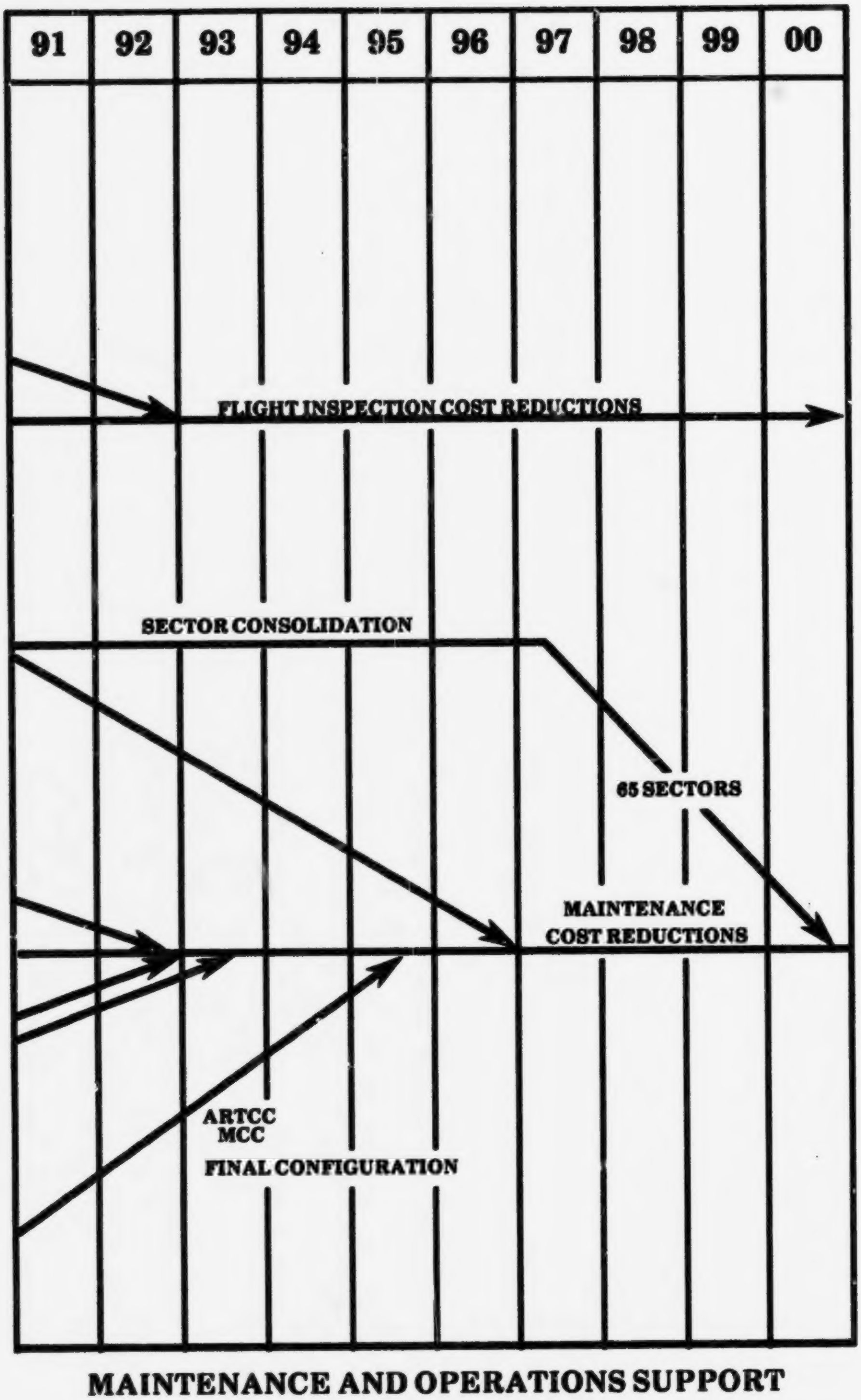
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FLIGHT INSPECTION COST REDUCTIONS
SECTOR CONSOLIDATION
65 SECTORS
MAINTENANCE COST REDUCTIONS
ARTCC MCC
FINAL CONFIGURATION

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS EVOLUTION

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OTHER CAPITAL NEEDS

The NAS Plan has evolved over the past five years into the current set of integrated projects that present a realistic approach in meeting the ever-increasing demand for aviation services. As implementation of the Plan has progressed, new requirements have become apparent. This chapter presents the projects that have been established to meet these requirements. The new projects included on blue pages in this chapter respond to requirements beyond the scope of previous Plans. Both near-term and long-term efforts are discussed, with varying levels of maturity associated with each effort. Project maturity is proportional to expected implementation dates.

Long-term efforts require additional analysis before decisions are final. They have been included to acquaint the reader with FAA perceptions on future needs. As other aeronautical research and technology initiatives mature, additional plans for capital expenditures will be developed.

RELATED PLANS

THE FAA PLAN FOR RESEARCH, ENGINEERING, AND DEVELOPMENT (R,E,& D)

The FAA Plan for Research, Engineering, and Development (R,E,&D) describes the research, engineering, and development to support: F&E programs; regulatory functions of the agency, including certification, aviation safety, security, environmental protection, aviation medicine, and noise abatement; airport development, improvement, and planning; and advanced technological development and evaluation.

The plan has been developed by representatives of FAA in cooperation with representatives of the aviation industry and the flying public. It contains projects similar in appearance to those of the National Airspace System Plan for Facilities, Equipment and Associated Development (F&E), but addresses the larger area of research, engineering, and development interests. Projects contained in the NAS Plan for F&E, which have research and development components, are included in the FAA Plan for R,E,&D. Additionally, R,E,&D needs which may yield systems and equipment to be included in future editions of the NAS Plan for F&E are also contained.

ROTORCRAFT MASTER PLAN

The agency's Rotorcraft Master Plan defines the requirements and associated research and development efforts relating to producing facilities, airborne equipment, and procedures designed to solve the specific problems encountered by rotorcraft. These efforts will build upon the systems used for fixed-wing aircraft. Results will provide a cost-effective approach to meet the needs of both aviation users.

NATIONAL PLAN OF INTEGRATED AIRPORT SYSTEMS

The National Plan of Integrated Airport Systems is the airport planning counterpart of the National Airspace System Plan and is the successor to the National Airport System Plan. The Airport and Airway Improvement Act of 1982 sets forth the need for this plan which contains the ten year requirements for airport development and details the capital needs for improvement of the state and local government-owned airport components of the National Airspace System. The National Plan of Integrated Airport Systems is prepared in coordination with the NAS Plan. It is published every two years. The next publication is scheduled in 1987.

THE ENHANCED NATIONAL AIRSPACE REVIEW

The National Airspace Review (NAR) is a cooperative effort between Government and industry to improve the safe and efficient use of the Nation's airspace. The original efforts of the NAR have been completed, and its scope has been expanded to include a review of the airspace, procedural, and regulatory aspects of scheduled improvements envisioned under the modernization of the National Airspace System (NAS), and it is now identified as the NAR Enhancement Plan.

The National Airspace System Plan identifies capital improvements needed to safely meet the projected demands on air transportation between now and the year 2000. The NAR Enhancement Plan, in relationship to the NAS Plan, focuses on airspace and procedural aspects of the air traffic control system for the purpose of identifying the long-term operational considerations of, and potential adjustments to, an enhanced system as it evolves. To accomplish this, the NAR Enhancement Plan is conducting additional in-depth studies to identify, analyze, and document recommended changes which will be assessed to establish validated requirements for the system. This effort will provide the operational framework for a smooth transition into the next generation NAS with an accelerated realization of benefits. The work of the NAR was completed in late 1984 and the work of the NAR Enhancement Plan commenced in early 1985.

RESULTS OF THE PLAN

MAJOR DECISIONS

In conjunction with the planning process, FAA has made a series of major decisions which serve as the keystones of the system plan:

- The air traffic control system will continue to be fundamentally ground-based until the year 2000.
- TCAS I and TCAS II (traffic alert and collision avoidance system) will be independent airborne backups to the air traffic control system.
- A major computer/data processing system (including a new sector suite and new system software) will be procured. The new system will support en route and terminal functions and allow for consolidation.
- The highest practical level of air traffic control automation will be implemented.
- A modernized traffic flow management process will be implemented.
- Secondary surveillance radar (SSR) Mode S, with its integral data link, will replace the air traffic control radar beacon system (ATCRBS) at most locations.
- A new weather radar network will be provided for the air traffic control system. It will include NEXRAD and a terminal radar weather channel (ASR 9).
- A terminal Doppler weather radar system will be provided where needed to detect microbursts and wind shear in the path of landing and departing aircraft.
- FAA will proceed with upgrading ARTS II and ARTS III (automated radar terminal system).
- A major improvement and integration of the FAA communications system will be implemented.
- The automated flight service station system will be implemented, along with a major improvement in weather services to users.
- Direct automated pilot access to weather information will be provided. Automated weather observation systems will supplement or replace human observers.
- The instrument landing system (ILS) will be supplemented with, and then replaced by, the microwave landing system (MLS).
- Work will continue on improvement of airports as well as on higher airport/terminal capacity.
- FAA will proceed with extensive consolidation of facilities and the removal of the impact of artificial system boundaries on users.
- A major system engineering and integration contractor was employed to assist the FAA in the accomplishment of the the NAS Plan.

IMPLICATIONS FOR FAA PERSONNEL

The NAS Plan efforts will not only result in increased safety, user efficiency, and significant economies, but also in increased job satisfaction for FAA personnel. Both adequate capital resources and the personal commitment of field, center, regional, and headquarters personnel are essential for the successful implementation of the plan. The individual involvement of ATC specialists and AF technicians is necessary for well designed and operating systems. FAA personnel should expect implementation of the plan to enhance job satisfaction by replacing processes based on obsolete technology and routine repetitive manual tasks with ones supported by automation and the latest technology.

Some of the more notable implications for ATC specialists are:

- Improved traffic flow planning and management, resulting in more balanced workload and smaller "peaks".
- More reliable equipment, which minimizes the stress of equipment failure.
- Easier access to more timely data, allowing for improved service to the flying public.
- More emphasis on human interface requirements of new systems.

- Computer-based training which will reduce the need for training away from the home facility, especially in Air Traffic Control and Airway Facilities specialties.

- Improved real time simulation capability for training purposes.

- More precise definition of individual job specifications, leading to improved interaction and information transfer between team members.

- Automation of certain procedures to reduce workload.

- Enhanced displays with color and improved weather data.

The more significant implications for AF technicians are:

- Upgrading of individual skills to match the current technology.

- Improved analytical tools for more effective diagnosis and repair.

- Improved field communications capability.

- Emphasis on human factors engineering for less manpower-intensive maintenance.

IMPLICATIONS FOR USERS

As a result of the planned actions, users will be the beneficiaries of the following improvements:

- Increased safety through collision avoidance and improved weather information.

- Reduced delays.

- Improved fuel efficiency.

- Increased pilot-preferred routing.

Conceptually, all NAS modernization projects interrelate to improve the quality of service or assure the continuity of service through transition. There are physical dependencies, operational relationships, and common objectives which unify the NAS. These are found among the projects of the Plan. Increased automation of the air traffic control system and implementation of microwave landing systems, however, are notable contributors to increased safety, improved fuel efficiency, reduced delays, and increased pilot-preferred routing. Moreover, automated flight service stations and weather projects, such as weather radar, provide significant additional safety benefits.

Although no additional equipment will be required for most new services, users will need to purchase certain avionics related to TCAS, Mode S data link, MLS, and 25 kHz communications in order to maximize their benefits. The cost of these avionics will be borne by the user.

The following new requirements are anticipated to permit full participation in the system:

- ILS will be supplemented with, and subsequently replaced by MLS where needed. Airborne equipment will be needed to use this new service, with the need for a number of aircraft to carry dual ILS/MLS avionics during the transition.

- It is expected that after 1986, pilots who wish to receive full ATC service in all controlled airspace will need 720-channel VHF communications capability in their aircraft.

- While this plan does not anticipate mandatory carriage of Mode S or TCAS, it is expected that there will be widespread implementation of these systems.

RETURN ON THE INVESTMENT

The implementation of the Plan is expected to have the following results:

CAPABILITY

The resulting system will provide for planned, conflict-free, fuel-efficient flight paths. Safety will be improved by reducing system errors. Flight paths desired by airspace users will be accommodated on a regular basis. The growing demand of flight operations will be accommodated with a minimum of constraint and with the highest practical fuel efficiency. Dynamic flow management will reduce airborne delays.

EQUIPMENT BASE

Automation, navigation, surveillance, and landing system equipment will employ up-to-date technology. Like functions will utilize like equipment. A national network of facilities based on actual demand patterns and maintenance requirements will be in place. An efficient communications network will support individual facilities.

CONSOLIDATION

Fewer major manned control facilities will be required. Remote facilities will also be consolidated. Unique facilities as well as unique equipment types will be eliminated. The consolidation of facilities will reduce overhead costs. The logical grouping of compatible services using standardized communications, computer, and display elements (where practicable) will achieve efficiency and economy.

NAS PLAN BENEFITS

The lifecycle benefits, shown on page I-42 as bars, begin with the completion of each of 10 systems or categories of improvements and stream in over the typical life cycle of the ATC equipment delivered in each category (20 years). The total value of the FAA benefits will amount to $24.4 billion in 1981 dollars. When an estimate of $41.8 billion for user benefits (efficiency and safety) is added, the total benefits equal $66.2B.

The completion of the National Airspace System Plan will bring about operations cost efficiencies and productivity gains. Implementation of the Plan will offset FAA costs required to meet the increasing demands of air traffic growth on a system inadequate to handle them. These offsetting effects will allow the FAA to operate the system at or below the 1980 cost levels through the year 2000, when adjusted for inflation. When measured against 1980 air traffic control productivity and the rising maintenance cost of aging equipment, this cost containment is shown to have a significant return on investment to the FAA. Further, users of the System will benefit from improvements in flight services, more efficient routing, reduced delays, and even greater safety.

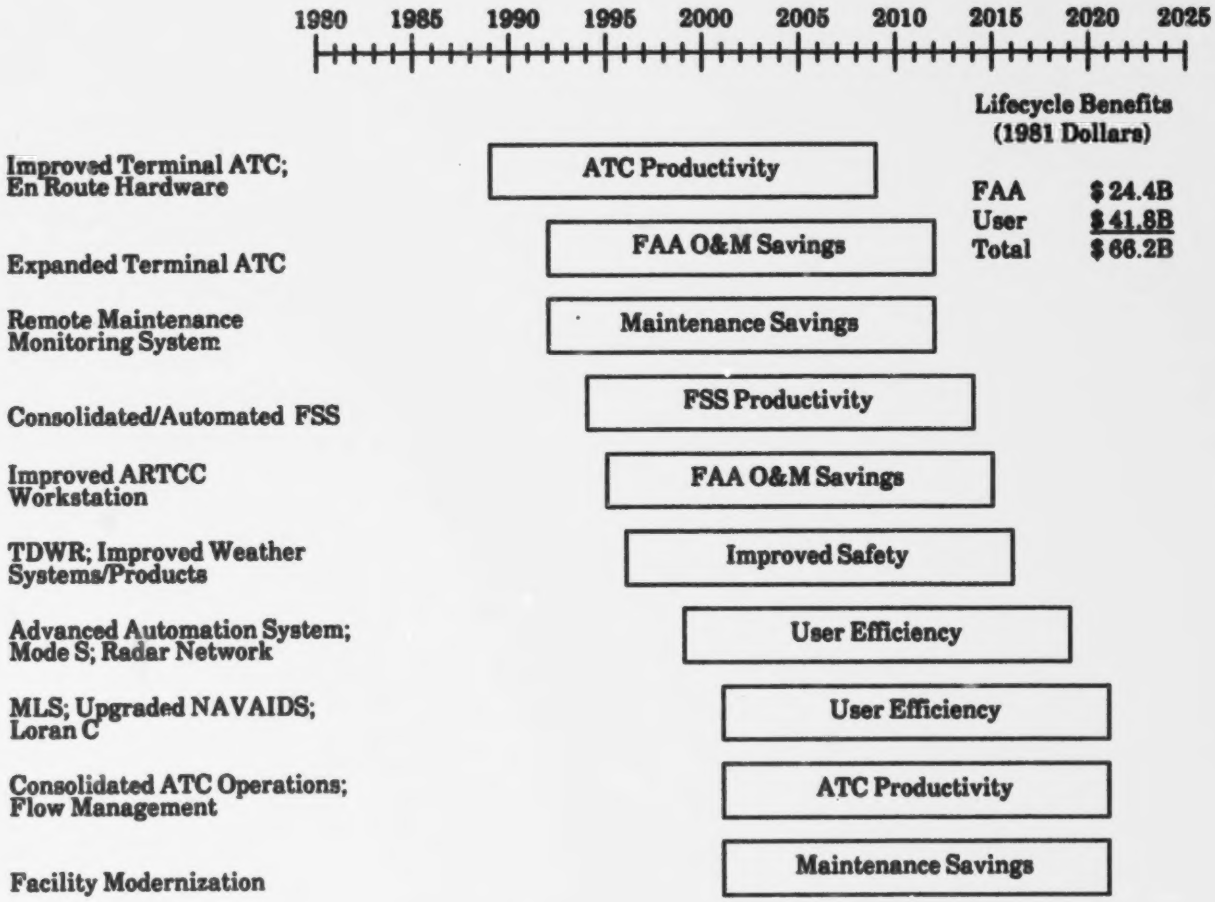
User benefits accrue from increased availability of user-preferred routes and altitudes, and reductions in delays. The functional capabilities needed for increases in user-preferred routes and altitudes are primarily provided by the AAS and AERA projects. These projects will reduce the need for procedural route/altitude restrictions now required to insure safe aircraft separations, and will thus increase the availability of fuel efficient altitude assignments and routes. These developments will result in user savings of time, fuel and non-fuel aircraft operating costs.

Reductions in delays will result from functional capabilities provided by such projects as AAS, AERA, Host, ERM, TMS and MLS. These projects will allow greater use of available NAS capacity, thus reducing delays under peak traffic conditions. Supporting these hardware and software resources are the surveillance capabilities provided by Mode S and an improved radar network, which collectively provide more accurate and comprehensive positional data needed for enhanced traffic management. Additionally, weather projects with improved sensor detection and real time dissemination capabilities, can be expected to contribute to delay reductions.

Safety benefits are generated by projects which improve aircraft surveillance, weather detection and information distribution, and air navigation capabilities. Projects such as ARSR 4, ASR and Mode S increase the likelihood that conflict situations will be identified and corrected before aircraft are placed at risk. Projects such as AWOS, NEXRAD, and TDWR monitor weather conditions, and provide up-to-date information and advise pilots when weather conditions become adverse. Navigation projects provide pilots with data which lessens the danger of operating with insufficient information. LORAN C will, for example, provide navigation assistance in remote areas that have previously lacked such service.

The productivity of ATC personnel will be improved by NAS Plan programs which generate previously unavailable information, or automate routine functions that currently require controller or traffic management attention. Ergonomic factors, such as color displays, are being designed into these projects, and will also contribute to productivity and/or safety. Finally, consolidation of ATC facilities is expected to reduce the coordination workload associated with operations involving adjacent facilities.

Control of ATC facility maintenance costs will be achieved through improved reliability and maintainability inherent in new or modernized hardware/software (e.g., solid state devices are inherently more reliable than their tube counterparts), and through improved maintenance diagnostics that are designed into such facilities (i.e., built-in test equipment). These developments will result in lowered AF manpower requirements, reductions in diagnostic and repair equipment requirements, and elimination of parts inventories required to support equipment that is no longer in production.



NAS PLAN LIFECYCLE BENEFIT STREAMS
(PRIMARY BENEFIT)

OPERATIONS COST

Costs shown on the table below are in 1981 dollars and reflect the expected annual operations costs for each of the years listed. Costs are in millions of dollars. Outyear estimates of operations costs are reviewed annually and are subject to revision.

	1981	1985	1990	2000
Air Traffic Personnel	$ 847	$ 757	$ 775	$ 638
Airway Facilities Personnel	$ 369	$ 330	$ 283	$ 264
Leased Communications	$ 93	$ 130	$ 192	$ 184
Rents, Utilities, Other	$ 102	$ 131	$ 169	$ 202
Totals	$ 1,411	$ 1,348	$ 1,419	$ 1,288

CONCLUSION

This Plan identifies the capital investment required to modernize and consolidate the air traffic control system, the major R&D and F&E programs to accomplish it, the strategy to carry it out, and the major decisions facing the Administration and Congress to ensure its success. The Plan will:

- Permit the evolution of the system from a segregated (en route, terminal, etc.) to an integrated system.
- Ensure no degradation or loss of existing services.
- Improve services where deficiencies exist.
- Accommodate increasing traffic levels and demands for services achievable within the physical limitations of the system.
- Reduce future staffing levels and operations and maintenance costs in 1981 dollars.

Implementing the Plan will be expensive and will proceed more slowly than many would wish. However, the technological innovations provided, the equipment obsolescence avoided and the constrained expenditures which result, make the Plan practicable.

The Plan requires annual funding in order to be executed efficiently. There will be continuous Executive and Legislative oversight; but, a continuing commitment to the funding levels is necessary to execute the Plan.

CHAPTER II

DEMAND ON THE SYSTEM

DEMAND ON THE SYSTEM

The United States National Airspace System is the busiest and most complex in the world. The airspace accommodates over 235,000 active civil and military aircraft. Performance characteristics of these aircraft vary widely and the missions flown have differing impacts on the system. The overall trend is toward the production of more sophisticated aircraft which make greater use of controlled airspace and the services which FAA provides.

The continuing growth in the number of aircraft operations, diversity of operations, number of aircraft, and sophistication of aircraft will place unprecedented demands on the National Airspace System from now through the turn of the century. In addition, the full effects of the Deregulation Act of 1978 and the resulting increase in competitive scheduling, lower prices, new airline entries, and airport hubbing will continue to place extra demands on the system. The safe and efficient operation of the National Airspace System will require improved services, new facilities for system expansion and the orderly replacement of aging facilities, and the provision of adequate airport capacity.

Despite its high level of safety, the National Airspace System is not without difficulties. Problems of expanding capacity at congested airports, the provision of more direct routings, and the accommodation of greater numbers of sophisticated aircraft must be dealt with effectively.

GENERAL SYSTEM DEMAND

Forecasts indicate that demand in terms of aviation activity will increase substantially in the next two decades. Table I depicts the growth anticipated in aviation demand for the years 1990 and 2000.

OPERATIONS AND ENPLANEMENTS

Aircraft operations, including takeoffs and landings at all towered and nontowered airports in the National Airport System Plan (NASP) (the forerunner to the National Plan of Integrated Airport Systems (NPIAS)), are anticipated to grow by 42 percent between 1982 and 2000, with itinerant operations increasing 66 percent. Itinerant operations refer to those aircraft departing to or arriving from an area outside an airport's local operating area. A breakdown of aircraft operations for the different types of civil airports can also be found in Tables II and III. Table IV provides information concerning military-owned and -operated airports. Instrument operations, including each time that separation is provided in a terminal area by an air route traffic control center (ARTCC) or FAA terminal approach facility (an indicator of terminal instrument flight rules (IFR) operations), will increase by 76 percent. En route IFR aircraft handled (an indicator of ARTCC operations) will increase by 69 percent. Flight service station (FSS) operations, including pilot briefings, flight plan origination, and aircraft contacted, will decrease by 10 percent. Domestic enplanements include all enplanements for the activity indicated, regardless of airport type. Air carrier domestic enplanements are expected to increase by 159 percent and commuter enplanements by 255 percent.

AIRCRAFT HOURS, FLEET, AND PILOTS

Air carrier hours flown are forecast to increase 110 percent, general aviation hours flown decrease 2 percent, and military hours flown increase 15 percent. The number of air carrier aircraft will increase by 72 percent, commuter aircraft by 57 percent, general aviation by 4 percent, and the helicopter fleet by 29 percent.

The mix of the general aviation fleet will be altered dramatically during this period. The single-engine piston fleet, which normally operates visual flight rules (VFR) below 12,000 feet, will decrease from 168,000 to 163,000 aircraft. The more sophisticated twin-engine and turbine-powered aircraft will comprise the fastest growing segment of the fixed-wing fleet, increasing from 33,000 to 39,500 aircraft. The number of pilots will decrease by 4 percent, but those with instrument ratings will grow by 7 percent.

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MILITARY AVIATION REQUIREMENT

Response to military requirements places special demands on the National Airspace System, particularly in en route airspace. The FAA also provides approach control services for over half of the 233 military airfields in the United States. This service is in addition to over 50 approach control facilities and 180 control towers that are operated by the military. The Department of Defense operates over 20,000 aircraft within the National Airspace System, flying approximately 6 million hours a year. Over 90 percent of this flying is dedicated to training missions. These training missions include high-speed maneuvering flight in all altitude bands, with increasing need for very low-level operations. Increased air refueling activity, air drop missions, and frequent large-scale joint exercises require close coordination with civil traffic flows. The increased speed, range, and capabilities of military flight operations also indicate that a higher level of demand will be placed on the National Airspace System for training and testing, even though the total number of military aircraft will remain relatively constant. A relatively small amount of airspace is reserved exclusively for military use. Therefore, there will be a need for continued coordination and improved navigation and air traffic control service as growing civil aviation and military aviation requirements must be accommodated within common airspace.

TABLE I. TOTAL NATIONAL AIRSPACE SYSTEM ACTIVITY

	1982	1985	1990	2000	Percent Growth 1982-2000
NPIAS Airports (Existing)*	3195	3219	3472	3699	15.8
Airport Operations (millions)					
Aircraft Operations	127.6	143.0	139.5	181.3	42.1
Itinerant Operations	68.0	78.8	84.7	113.0	66.2
Instrument Operations	31.7	38.7	45.4	55.8	76.0
Towered Airport Operations	50.6	57.9	65.7	82.2	62.5
ARTCC Operations (millions)					
IFR Aircraft Handled	27.9	32.7	38.7	47.2	69.2
ACF Approach Control Operations**	----	----	----	55.4	----
FSS Service (millions)	62.4	52.9	49.3	56.3	(9.8)
Hours Flown (millions)					
Air Carrier	6.1	7.4	10.1	12.8	109.8
General Aviation	37.8	36.6	34.0	37.1	(1.9)
Military	6.2	5.9	6.4	7.1	14.5
Domestic Enplanements (Revenue Passenger) (millions)					
Air Carrier	272.8	348.4	468.5	707.2	159.2
Commuter	17.8	24.2	34.6	63.1	254.5
Aircraft Fleet (thousands)					
Air Carrier	2.5	2.9	3.6	4.3	72.0
Commuter***	1.4	1.5	1.7	2.2	57.1
Total General Aviation	213.3	220.9	208.7	222.0	4.1
Civil Helicopter***	7.0	7.1	7.0	9.0	28.5
Total Military	21.7	19.9	21.2	22.2	2.3
Military Helicopter***	9.7	7.3	8.9	9.3	(4.1)
Pilots (thousands)					
Instrument Rated	252.5	256.6	264.7	277.0	9.7
Total Pilots	764.2	722.4	697.4	731.0	(4.3)

* Aircraft operations forecasts are based on the existing airports included in the National Plan of Integrated Airport Systems (NPIAS).

** Approach control operations conducted for area control facilities equal the number of instrument operations conducted by towers.

*** Civil Helicopter and Commuter Fleets are included in the Total General Aviation Fleet. Military Helicopter Fleet is included in Total Military Fleet.

TABLE II. COMMERCIAL SERVICE AIRPORT ACTIVITY

	1982	1985	1990	2000	Percent Growth 1982-2000
Large Hub Commercial Service*					
Airports	24	28	29	31	29.2
Operations (millions)	8.2	11.1	12.4	15.5	89.0
Enplanements** (millions)	196.3	280.3	354.8	509.7	159.7
Based Aircraft (thousands)	2.4	3.5	3.6	3.7	54.2
Other Commercial Service***					
Airports	521	518	570	602	15.5
Operations (millions)	53.8	40.0	39.2	59.3	10.2
Enplanements** (millions)	112.7	125.2	143.2	243.9	116.4
Based Aircraft (thousands)	61.0	60.3	65.0	70.0	14.8

* Airports at which over 1 percent of total U.S. passengers are enplaned.

** Includes scheduled and nonscheduled traffic by domestic and foreign flag carriers, commuters, and air taxis.

*** Airports receiving regularly scheduled service when 2,500 or more passengers are enplaned annually (excludes large commercial airports).

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TABLE III. GENERAL AVIATION AIRPORT ACTIVITY

	1982	1985	1990	2000	Percent Growth 1982-2000
Reliever Airports					
Airports	202	227	273	314	55.4
Operations (millions)	20.0	26.6	27.2	34.0	70.0
Based Aircraft (thousands)	44.3	55.5	56.8	71.5	61.4
General Aviation Airports					
Airports	2424	2440	2600	2752	13.5
Operations (millions)	45.6	65.3	60.7	72.5	59.0
Based Aircraft (thousands)	67.9	79.4	74.6	69.8	2.8

TABLE IV. MILITARY AIRPORTS

	1982	1985	1990	2000	Percent Growth 1982-2000
Airports	233	233	233	233	00.0
Operations (millions)	24.7	26.7	28.6	30.5	23.5
Military	21.7	23.1	24.3	25.5	17.5
Civil	3.0	3.5	4.3	4.6	53.5

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AIRPORTS IN THE UNITED STATES

There are about 16,300 landing areas in the United States, of which over 5,800 are open to the public.

Currently the nation's most important civil airports are included in the National Plan of Integrated Airport Systems (NPIAS) prepared bi-annually by the Federal Aviation Administration, consistent with the Airport and Airway Improvement Act of 1982. The plan includes the type and estimated costs of eligible airport development work in coordination with the National Airport System Plan necessary to provide a safe, efficient system of public-use airports.

The Administration's proposed post-1987 legislation would replace the NPIAS with the requirement for a report on the safety and capacity of the national system of airports, which would describe the current operating characteristics and future needs of the national system of airports. This would include the needs of civil aeronautics, requirements in support of national defense, and the identified needs of the Postal Service.

OPERATIONS

Today, civil airports handle about 143 million aircraft operations and enplane over 400 million passengers. They accommodate over 235,000 aircraft.

Airport development is largely the responsibility of state and local governments. The Federal Government participates in development at the request of state and local governments through its airport grant program and encourages airport planning and development to enhance safety, reduce congestion, and protect the environment.

Airport activity will increase substantially by the year 2000. Accommodating this additional demand will be more difficult in the future than it has been in the past. Although most of the nation's airports will have adequate airside capacity through the turn of the century, many of our key metropolitan areas are now congested and many more are expected to become congested before the turn of the century. In many metropolitan areas, there is little or no reserve capacity and the potential for airside expansion is limited. Though only a relatively small percentage of airports are involved, they handle a disproportionately high percentage of scheduled passengers. The 28 largest commercial airports enplane approximately 70 percent of all passengers.

In nonmetropolitan areas, needed capacity may usually be obtained through conventional construction of runways and associated taxiways.

The basic methods for adding airport capacity in congested areas are:

- New or improved pavement at existing airports.
- Procedural changes such as reduction in longitudinal (in-trail) and lateral (e.g., separation between centerlines of parallel runways) separation standards.
- Terminal area flow optimization.
- New airports.

Some increases in airport capacity will result from FAA's broad efforts to modernize the National Airspace System which include improved techniques for metering and controlling traffic flow and the implementation of the microwave landing system. Further increases in capacity and reductions in delay may potentially be realized through the use of converging instrument approaches, development of short parallel runways for smaller aircraft, reduced spacing between runways for independent instrument flight rules (IFR) operations, and triple parallel instrument approaches.

These measures will provide an important share, but not all, of the required increase in airport system capacity. Construction of new airports and new or improved pavements at existing airports provide the largest incremental gains to capacity. To the extent possible, FAA is encouraging use of airport planning and development grants for capacity-related projects at airports that are now congested or are expected to be congested within the next decade.

In some communities it will not be feasible to expand existing airports to accommodate forecast demand. Therefore, local and state governments must consider the construction of new major airports. The FAA will play an active role, as anticipated at Denver, in supporting such studies and providing local officials with appropriate aid to alleviate adverse environmental impact and overcome financial obstacles. There are major obstacles to new airport construction in metropolitan areas, but there are also substantial gains to be achieved when new procedures or airport improvements are made.

Establishing new major airports involves large financial, environmental, and land-use commitments. When the new proposed airports replace existing airports, large economic dislocations may result. It is for these reasons that metropolitan areas, when faced with overcrowded airports, seek alternatives to new construction. These alternatives can be broadly grouped as:

- Increasing the capacity and efficiency of existing airports through technical changes, scheduling changes and/or possibly peak pricing.
- Encouraging the use of aircraft with greater seating capacity.
- Increasing the use of existing secondary airports within the hub.

Further increases in the capacity of existing airports are possible through conventional construction (such as new runways) when feasible, incorporation of new and improved technology into the air traffic control system and related areas, and use of improved and innovative air traffic control procedures. Delays at individual airports may also be reduced by local authorities through spreading and/or meeting peak-hour traffic through regulatory or economic devices and encouraging the restructuring of airline service patterns so that connecting flights are not concentrated at a few large cities.

The second area for achieving increased capacity by employing large aircraft has been a key factor in accommodating growth for the past 20 years. The average seating capacity of large commercial aircraft has grown from less than 50 in 1950 to about 152 today. A significant part of projected passenger growth will continue to be absorbed through the use of larger aircraft. Adding more seats to existing aircraft and higher load factors will also contribute. Table II indicates that, at large airports, rate of passenger growth is about twice the growth of aircraft operations.

The severe aircraft delays experienced at certain major hub airports illustrate the need for increased airport capacity. Some increases in capacity can be achieved through greater use of secondary airports. To do this will require improving some reliever airports and constructing new ones, as well as more intensive use of existing second or third airports for scheduled service. The following chart depicts the number of airports that are presently congested through the turn of the century, if additional capacity is not provided through new construction or implementation of capacity-enhancing programs.

Alleviation of congestion through demand reduction by either economic or regulatory means is not reflected. Priority will be given to research and facilities projects which show promise of reducing congestion at airports. Priority will also be given under the airport grant program to projects which may alleviate congestion.

The Administration's proposed post-1987 airport and airway legislation includes a restructured airport grant program which provides an expanded program focus on airport capacity enhancement. Through a significantly enlarged discretionary fund, incorporating a capacity set-aside, the grant program targets one-third of total available funds for projects which enhance system capacity. Airport noise and reliever airport projects which expand system capacity will also be eligible for these discretionary funds. While enhanced airport safety is the primary thrust of the annual airport grant program proposal, the emphasis on airport system capacity will allow gains in airspace capacity through implementation of the NAS Plan to be matched by gains in airport capacity.

FUTURE REQUIREMENTS

Facilities and equipment, both federally and locally provided, will be needed in response to increases in demand, the provision of new or improved services, and the growth in number of airports. Figures associated with the following maps illustrate the anticipated distribution of airports, facilities, and equipment in four time frames: 1981, 1985, 1990, and 2000. Figures are provided for each airport type (commercial service, primary, general aviation, and reliever).

The figures for each airport group show: (1) the growth in airport quantities and demographics and (2) the correlation of probability that particular services will be provided with respect to the various types of systems or equipment serving that type of airport. Airports that do not meet FAA benefit/cost criteria for approach guidance or air traffic control services may be provided facilities through non-Federal sources. Additionally, airports which meet FAA benefit/cost criteria for air traffic control services may be more economically staffed through contract services.

SERVICES TO AIRPORTS

The following charts depict the congested airports; past, current, and future distribution of airports; and federal services provided, as well as those service expansions expected from the implementation of the programs described in the NAS Plan. Separate charts are included for each category as defined below.

Large Commercial Service Airport (Formerly called Primary Airport): An airport with scheduled passenger service which is determined by the Secretary to have .01 percent or more of the total number of passengers enplaned annually at all airports which receive scheduled passenger service of aircraft and which enplane annually 2,500 or more passengers.

Small Commercial Service Airport (Formerly called Commercial Service Airport): An airport with scheduled passenger service and not less than 2,500 enplanements which is determined by the Secretary to have less than .01 percent of the total number of passengers enplaned annually at all airports which receive scheduled passenger service of aircraft and which enplane annually 2,500 or more passengers.

Reliever Airport: An airport including heliport, designated by the Secretary as meeting criteria developed by the Secretary, based on relieving current or forecast congestion at a large commercial service airport and providing more general aviation access to the overall community.

General Aviation Airport: This airport classification is no longer defined as a separate category in the proposed legislation; however, for the purposes that it is used in this chapter, it is defined as all other airports listed in the NPIAS that are not designated as commercial service or reliever airports.

The Administration's proposed post-1987 legislation would replace the NPIAS as prescribed by current law with a requirement for a report on safety and capacity on the national system of airports. The above definitions have been changed accordingly to match those in the proposed legislation.

AIRPORTS TO EXPERIENCE SIGNIFICANT CONGESTION*

YEAR	COMMERCIAL SERVICE	GENERAL AVIATION	TOTAL
1981	10	4	14
1985	17	8	25
1990	30	21	51
2000	58	51	109

* The airports shown in the above table have been estimated to greatly exceed their Practical Annual Capacity (PANCAP)

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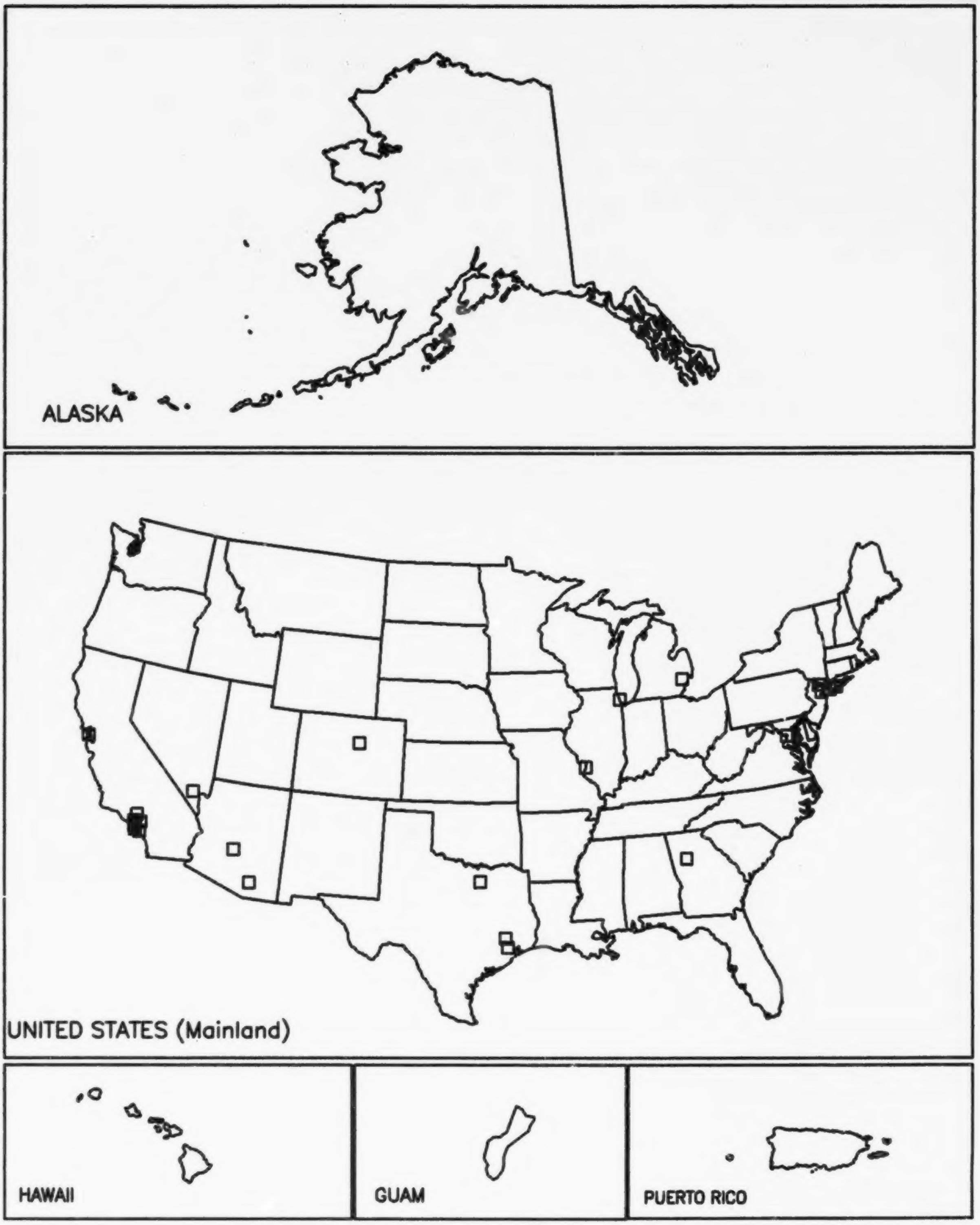
ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1985 CONGESTED AIRPORTS

LARGE COMMERCIAL SERVICE AIRPORTS							
YEAR	NUMBER OF AIRPORTS	NO FAA EQUIP	VISUAL AIDS ONLY	VISUAL AND PRECISION APPROACH AIDS	TOWER AND VISUAL AIDS	TOWER AND PRECISION APPROACH AIDS	TOWER RADAR SERVICE AND PRECISION APPROACH AIDS
1981	279	0	0	25	8	74	172
1985	274	0	0	24	9	61	180
1990	280	0	0	26	2	53	199
2000	280	0	0	26	2	49	203

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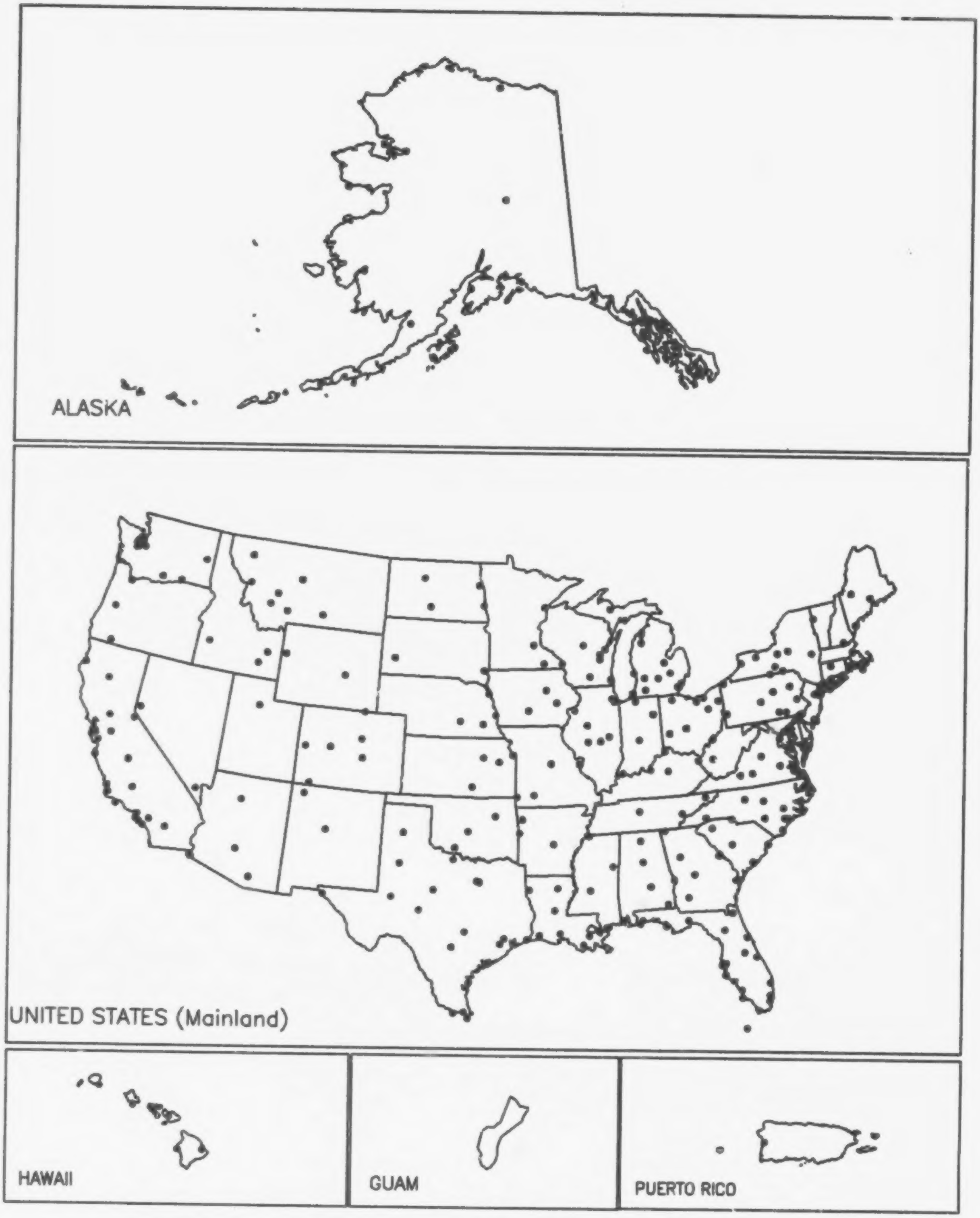
ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1985 LARGE COMMERCIAL SERVICE AIRPORTS

55

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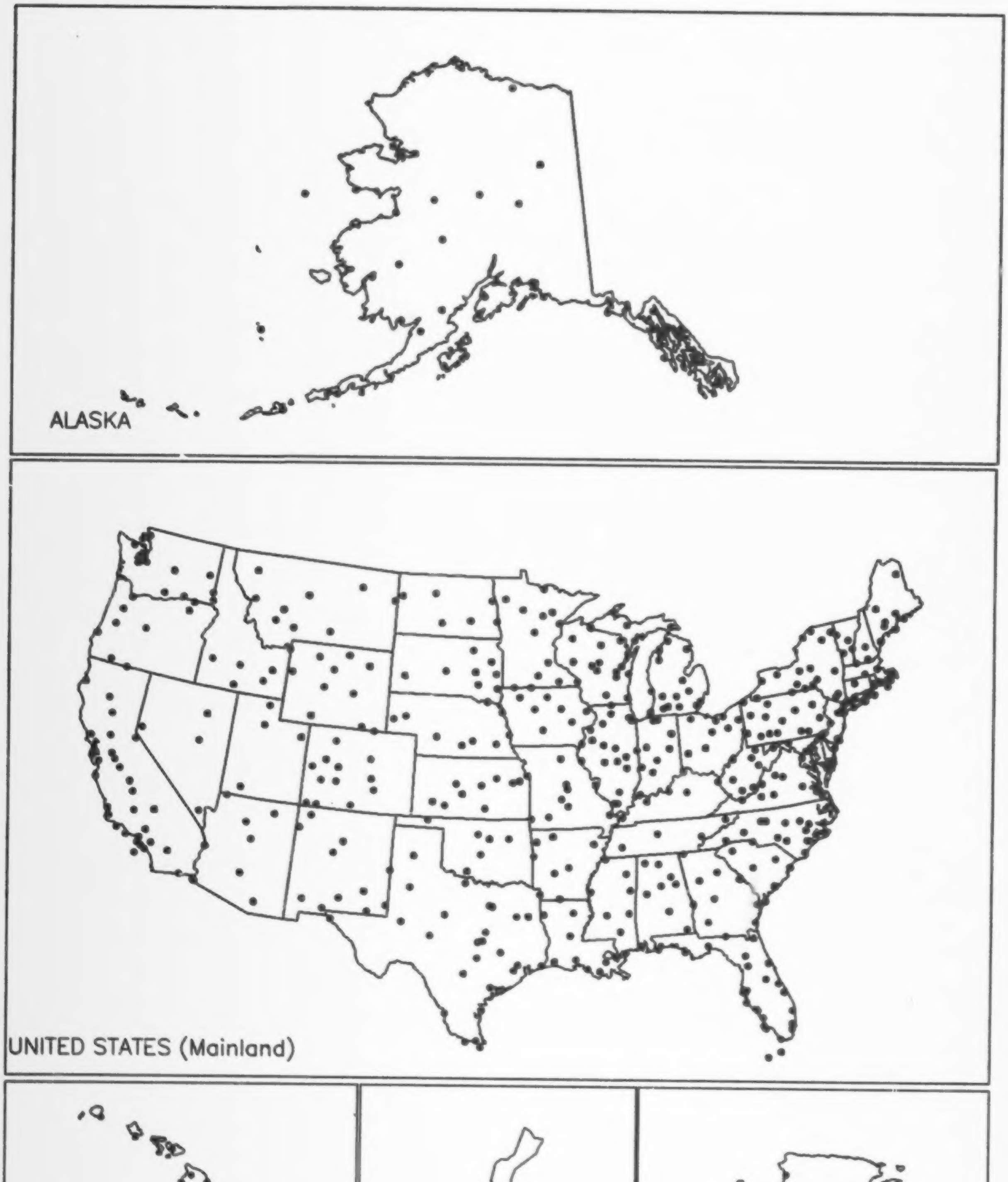
SMALL COMMERCIAL SERVICE AIRPORTS

YEAR	NUMBER OF AIRPORTS	NO FAA EQUIP	VISUAL AIDS ONLY	VISUAL AND PRECISION APPROACH AIDS	TOWER AND VISUAL AIDS	TOWER AND PRECISION APPROACH AIDS	TOWER RADAR SERVICE AND PRECISION APPROACH AIDS
1981	493*	244	77	100	5	56	11
1985	272	57	43	107	5	49	11
1990	319	74	12	162	2	50	19
2000	353	6	17	258	2	50	20

* Between 1981 and 1985, approximately 190 commercial airports were redefined as general aviation.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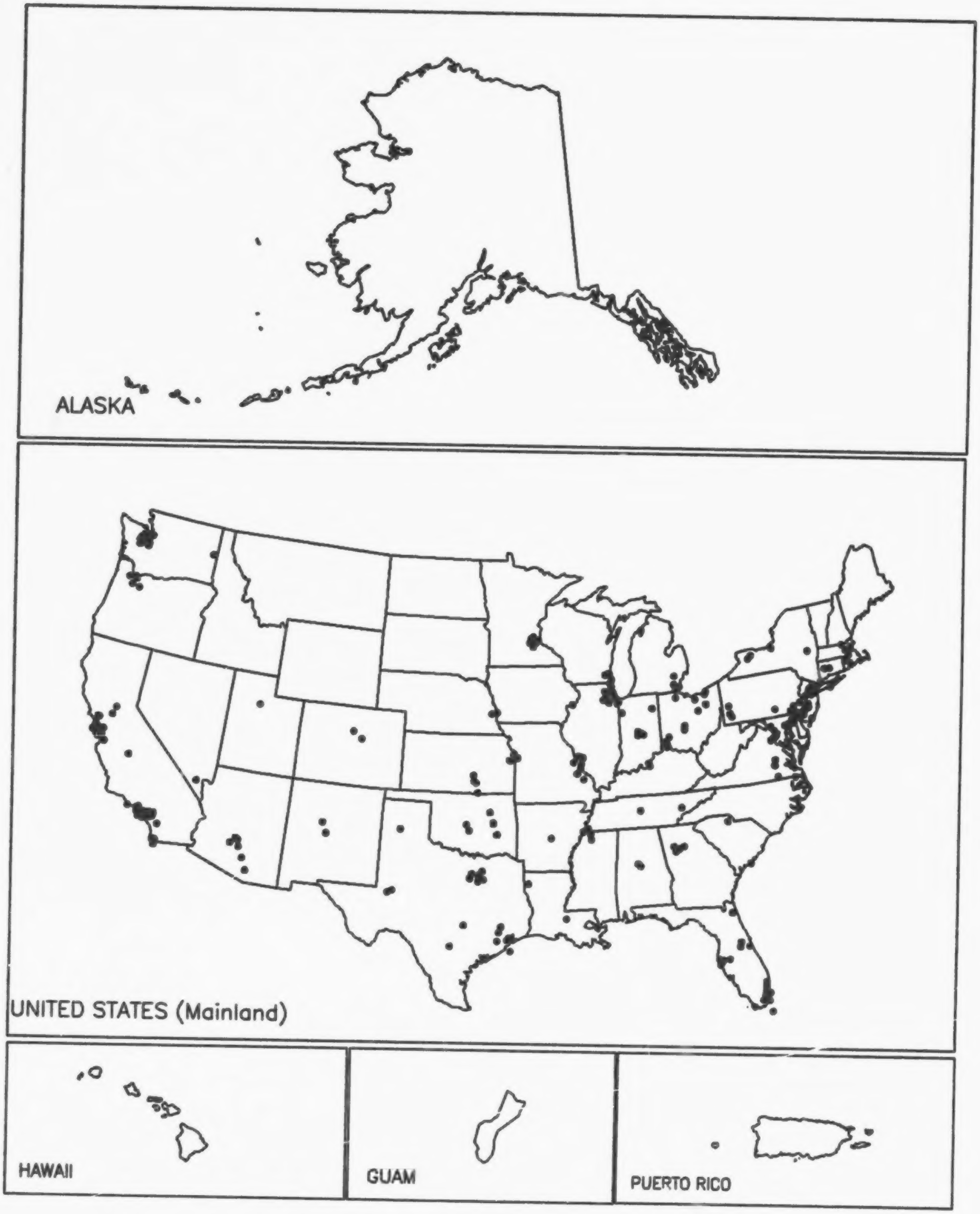
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1985 SMALL COMMERCIAL SERVICE AIRPORTS

RELIEVER AIRPORTS							
YEAR	NUMBER OF AIRPORTS	NO FAA EQUIP	VISUAL AIDS ONLY	VISUAL AND PRECISION APPROACH AIDS	TOWER AND VISUAL AIDS	TOWER AND PRECISION APPROACH AIDS	TOWER RADAR SERVICE AND PRECISION APPROACH AIDS
1981	163	70	7	11	31	41	3
1985	227	100	17	24	25	20	41
1990	273	90	0	100	3	17	63
2000	314	3	7	220	3	20	61

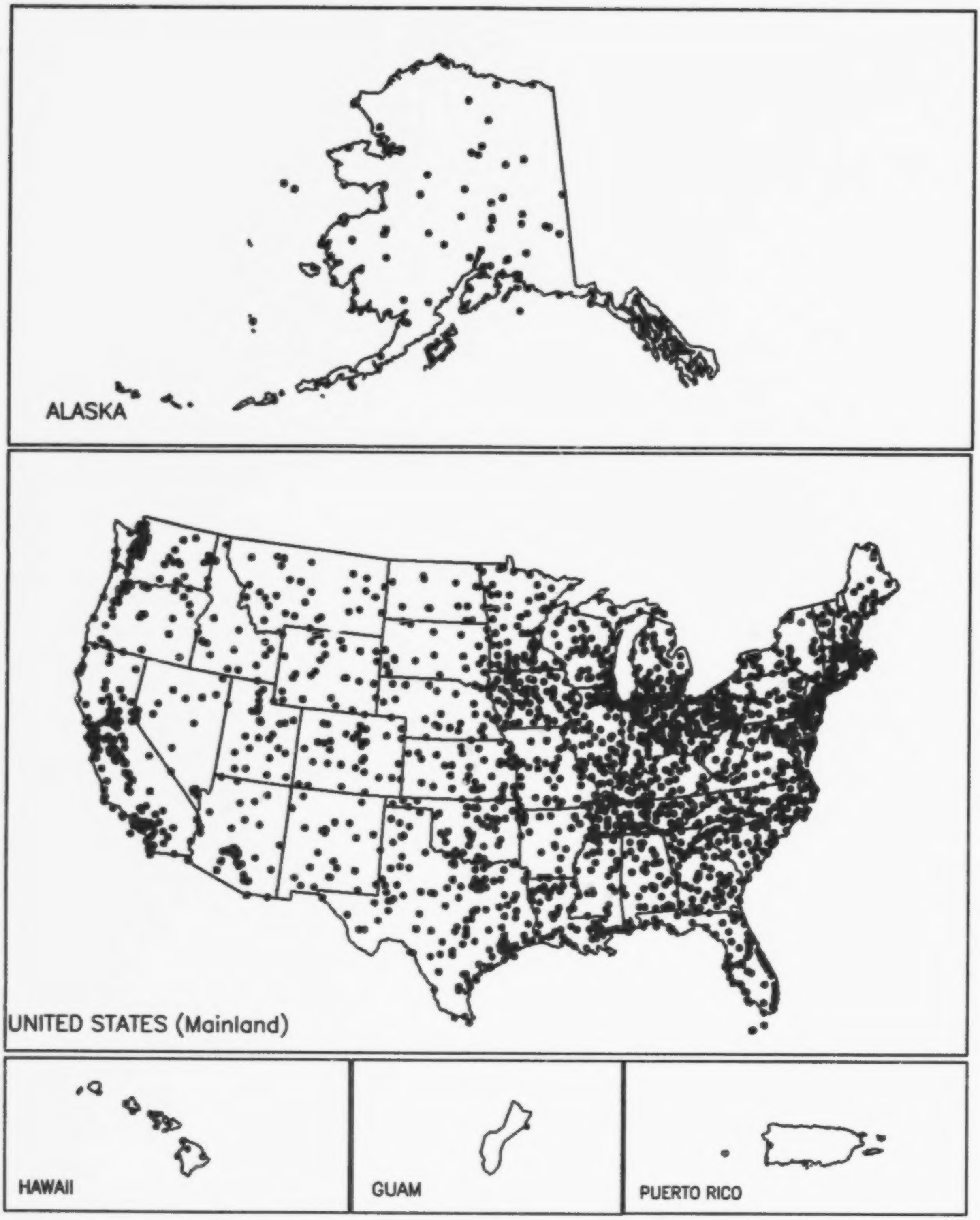

ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1985 RELIEVER AIRPORTS

GENERAL AVIATION AIRPORTS

YEAR	NUMBER OF AIRPORTS	NO FAA EQUIP	VISUAL AIDS ONLY	VISUAL AND PRECISION APPROACH AIDS	TOWER AND VISUAL AIDS	TOWER AND PRECISION APPROACH AIDS	TOWER RADAR SERVICE AND PRECISION APPROACH AIDS
1981	2,228*	2,071	81	45	12	19	0
1985	2440	2195	148	67	8	17	5
1990	2600	2380	137	60	7	8	8
2000	2752	2465	4	262	3	12	6

* Between 1981 and 1985, approximately 190 commercial airports were redefined as general aviation.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1985 GENERAL AVIATION AIRPORTS

AIRBORNE EQUIPMENT UTILIZATION

Projected utilization of airborne equipment in the next two decades is illustrated in Table V.

- Navigation. Use of VORTAC, a co-located very high frequency omnidirectional range (VOR) station and tactical air navigation (TACAN) facility; area navigation, VOR with distance measuring equipment (DME); and, to a lesser extent, nondirectional beacons (NDB) are expected to continue through the end of the century. More advanced systems for 4-dimensional area navigation (RNAV) should become commonplace by the year 2000. The use of satellite navigation will increase, but still be too new to be in widespread use.

- Communication. Use of very high frequency (VHF) communications is anticipated to remain predominant throughout the period. By 2000, there will be widespread use of the Mode S transponder and data link system, VOR weather data broadcasts, and high frequency (HF) data link. Although not commonplace, satellite communications will be on the increase.

- Separation. The air traffic control radar beacon system (ATCRBS) transponders will be replaced by Mode S transponders. The traffic alert and collision avoidance system (TCAS) will provide airborne collision avoidance capability.

- Landing Systems. The microwave landing system (MLS) will replace the instrument landing system (ILS) where needed as the standard for precision approaches. Area navigation and Categories IIIA and B approaches are also expected to be in increasing use. The head-up display (HUD) will be receiving increased use.

TABLE V. UTILIZATION

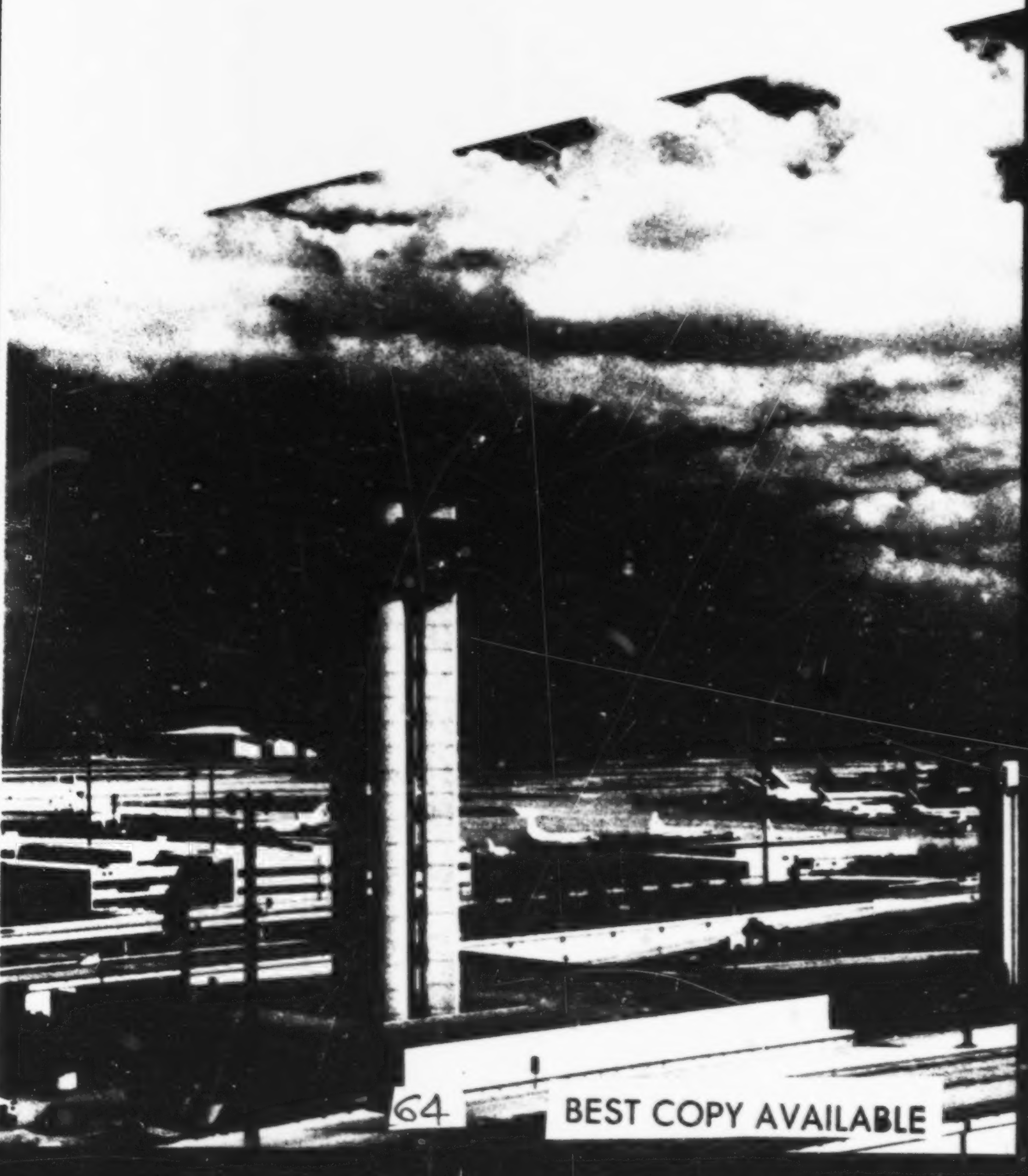
	1982	1985	1990	2000
NAVIGATION				
VOR/VORTAC	W	W	W	W
SATELLITE NAV (GPS)	N	N	L	L
DME	W	W	W	W
INS	L	I	I	W
LORAN C	L	I	I	W
NDB	W	W	W	W
RNAV	W	W	W	W
4D RNAV	L	I	I	W
COMMUNICATIONS & DATA LINK				
VHF COMM	W	W	W	W
UHF COMM	L	L	L	L
HF COMM	W	W	W	W
MODE S	N	N	L	W
ACARS	W	W	W	W
SATELLITE	N	N	L	I
VHF WX DATA BROADCAST (VOR)	L	I	W	W
HF DATA LINK	L	L	L	W
AIRCRAFT SEPARATION				
TCAS III	N	N	L	I
TCAS II	N	N	L	I
TCAS I	N	N	L	W
ATCRBS	W	W	D	D
MODE S	N	N	L	W
LANDING SYSTEMS				
MLS	L	L	I	W
ILS	W	W	W	D
ADF	W	W	W	W
VOR	W	W	W	W
RNAV	L	L	I	W
CAT IIIA	L	L	I	I
CAT IIIB	L	L	L	L

Legend:

D - Decreasing Use
I - Increasing Use
L - Limited Use
N - Nonexistent
W - Widespread

CHAPTER III

ATC SYSTEMS



ATC SYSTEMS

The three major components of the air traffic control system are en route air traffic control, terminal air traffic control, and flight service stations.

Air route traffic control centers (ARTCC) control all en route aircraft in the United States which are operating under instrument flight rules and are not under the control of military or other facilities. The centers provide separation service, traffic advisories, and weather information to pilots while they are en route between airports. Terminal air traffic control facilities include airport traffic control towers (ATCT), terminal radar approach control (TRACON), and terminal radar approach control in the tower cab (TRACAB). Airport traffic control towers separate and sequence aircraft in the airspace immediately surrounding airports and on the airport's surface. Approach control facilities provide separation services to aircraft during the arrival and departure phases of flights in a larger amount of airspace surrounding airports. Flight service stations offer a wide range of services to the large general aviation public which would not otherwise be available. Services include flight plan filing and closing, preflight and in-flight weather briefings, en route communications with pilots flying under visual flight rules, and assistance to pilots in distress. This chapter describes in detail the specific improvements that must be made to en route, terminal, and flight service station facilities in order to meet the demands of air transportation between now and the year 2000 in a manner which will not only improve today's high level of safety but achieve significant cost savings as well. The present artificial boundary between en route and terminal air traffic control will be increasingly invisible as the NAS Plan is implemented.

The improvements to the air traffic control components will be as follows:

- En route systems computers will be replaced, more functions will be automated, communications will be modernized, traffic management will be improved, and all functions will become more highly integrated.
- Terminal systems will be upgraded and expanded, software will be enhanced, communications will be improved/integrated, and some functions will be consolidated.
- Flight service systems will be consolidated and automated, weather information will be more current and widely disseminated, and communications will be integrated with other elements of the system.

The air traffic control system that is evolving from this Plan will be totally integrated, will greatly improve safety and efficiency, become more responsive to user needs, and accommodate increasing demand while minimizing costs.

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EN ROUTE

EN ROUTE SYSTEM

Commercial airlines and other aircraft flying under instrument flight rules and not under the control of military or terminal facilities are monitored by air route traffic control centers. These centers control an aircraft's route of flight between airports. They provide separation services, traffic advisories, and weather advisories. Aircraft flying under visual flight rules are also monitored by these centers if they are in an area that has radar coverage. In addition, they assist aircraft in distress. The FAA en route system is, of course, an integral part of this country's national defense system.

Another integral part of the en route system is the Central Flow Control Facility. The Central Flow Control Computer Complex was upgraded and moved from Jacksonville, Florida, to the FAA Technical Center in FY-84. The central flow control operational facility is the ATC Command Center in Washington, D.C. Central flow control serves as a focal point for evaluating and approving traffic flow redistribution and nationwide management of air traffic flow. It also provides authority for initiating systemwide flow control. Central flow control, associated with the Airport Reservation Function (ARF), relieves congestion at the busiest airports. When associated with the Central Altitude Reservation Function (CARF), it supports military operations and provides coordination of other activities requiring airspace protection. In times of emergency or calamity affecting an air traffic control facility, it also serves as the contingency command post (CCP) for coordinating and supporting major realignments of control responsibilities.

A typical center is responsible for more than 100,000 square miles of airspace and hundreds of miles of airways in the sky, which are like electronic highways to pilots. A current center's geographic area is usually divided into 30 or more sectors with a team of controllers responsible for each sector.

Today, there are 20 air route traffic control centers in the continental United States. There are four offshore centers located at Anchorage, Honolulu, San Juan, and Guam. The San Juan and Guam Centers are combined center radar approach controls (CERAP).

The air traffic control system determines correct aircraft separation based on radar data input. Flight data is displayed on paper strips torn from flight strip printers. Very high frequency (VHF) and ultra high frequency (UHF) radios are used to provide pilots with traffic advisories and route clearances.

Twenty en route centers presently use 9020 computers developed in the 1960s to process radar and flight data. Three offshore control centers using en route automated radar tracking system (EARTS) computers and one CERAP using a TPX-42 beacon system perform similar, but more limited, radar processing. Despite their capabilities, the current 9020 computer systems are not expected to be adequate for handling the projected growth in aviation traffic beyond the late 1980s.

The present en route center system is labor intensive. A great deal of manual effort and input is required of air traffic controllers. There are high hardware and software maintenance costs associated with its operation. Moreover, equipment manufacturers cannot provide parts indefinitely regardless of cost.

Higher levels of automation are being developed to reduce operational costs, improve safety, and provide fuel savings for aircraft users. Implementation of these enhancements is not possible because of capacity limits.

THE NEW APPROACH

The FAA's current en route modernization programs are aimed at replacing existing air traffic control computer systems with modern technology. New software will be implemented to enhance safety and increase productivity and permit the integration of a number of functions now performed separately. While somewhat costly, this program will provide for and accommodate future enhancements which best meet the FAA's objectives and, at the same time, greatly benefit the users of the National Airspace System (NAS).

The new computer system is being designed for approximately 100 percent functional availability and reliability of services. Moreover, the new computers, software programs, and displays now being developed will be capable of providing both en route and terminal services. This will enable the agency to consolidate and reduce the number of facilities needed. Airport traffic control towers will still provide airport services; however, significant savings in manpower, rents, utilities, and energy costs will be realized. Use of the same system for en route and terminal functions will also eliminate or considerably diminish the present, somewhat arbitrary, demarcation of services and, thereby, reduce operational overhead. Consolidation of TRACONs into area control facilities (ACF) will begin in the mid-1990s.

The new air traffic control computers will provide more reliable, safer services to the user; accommodate safety enhancements as they are developed; and enable the agency to reduce manpower, training, and logistics costs. Implementation of the automated en route air traffic control (AERA) functions will further enhance safety, controller productivity, and fuel savings for the users.

The first step towards modernization is the replacement of the 9020 central computer complex in the mid-1980s with a host computer. (A host computer is a replacement computer which uses existing software from another computer system.) This host computer will be capable of running the present 9020 software package with minimal modifications. This will provide immediate relief from current capacity restrictions and provide for projected air traffic growth until the advanced automation system is in place. The first host computer was delivered to the Seattle ARTCC in late 1986.

In August, 1984, competitive contracts were awarded to two companies for the design of new advanced automation systems (AAS), including sector suites with distributed processing computers. These contracts provide for the design of replacement software programs partitioned to run in centralized computers and sector suites. Operations requiring centralized processing will be accomplished in the centralized computers with all remaining functions performed within the individual sector suites. The designed reduced capability and emergency modes of AAS operation and sector suite processing capability will ensure that surveillance, flight, and weather data are provided with near 100 percent functional reliability. The acquisition approach minimizes the adverse impact of a major technical and operational transition. Additional safety and productivity functions will be included in the new software.

A typical sector suite will consist of displays which present a plan view of the current situation such as: (1) position of aircraft, and real-time weather; (2) electronic display of flight data (eliminating the need for the manual flight strip processing); and (3) the display of planning information and advanced functions such as AERA.

The voice switching and control system will provide automatic switching of communications. This capability will allow resectoring to meet demands. Leased-line and equipment costs will be reduced and permit eventual integration of voice and data communications. This will further reduce transmission costs.

The capability of the system to support both en route and terminal functions allows for consolidation into area control facilities. Standardization, flexibility, and expandability of the system's design will allow universal application, reduction of total operation costs, and facilitate accommodations of future requirements and enhancements.

The agency will enhance the central flow computer complex at the FAA Technical Center in the late 1980s to provide more coverage and prediction features for the NAS. The long-range goal will be to couple this traffic management capability with area control facilities for total national flow management.

In summary, the FAA's present en route plans are designed to replace current air traffic control systems with integrated systems designed to meet future needs for greater capacity and reliability. With higher levels of automation, present en route plans will improve both safety and productivity. The new system will be capable of providing both en route and terminal services, thereby, enabling the agency to consolidate and reduce the total number of facilities needed to do the job.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Development of the integrated advanced air traffic control system has begun. Development of interim capabilities and systems required to smooth the transition to the more highly automated system is nearing completion. And, implementation of improvements required to ensure the continued safe and reliable operation of the system in today's environment is well underway.

In mid-1984, contracts were awarded for the dual design competition phase of the advanced automation system (AAS) project. Development of ergonomic sector suites for area control facilities and airport traffic control towers and advanced computer processing capability began during this phase.

Development efforts of automated en route air traffic control (AERA) functions (performed by the AAS) are continuing. The system performance specification for AERA 1 was completed in 1984. AERA 2 concepts have been defined and will be validated in later phases of the program.

New voice communications switching capabilities are needed which complement the radar and flight data processing performed by the AAS to maximize controller productivity in ACFs. The specifications for VSCS prototype development have been completed.

Systems and capabilities are needed to provide processing capacity, improve safety, and improve operational efficiency throughout the transition period. The FAA has developed a replacement for its 9020 computers. A new host computer capable of running slightly modified 9020 software programs will provide the additional capacity needed to handle the growth in air traffic expected in the 1980s and improve system availability. Testing of competing host computers was completed and an acquisition contract was awarded in July 1985. Prototype software enhancements which improve safety or efficiency (en route metering, conflict resolution advisory, and conflict alert IFR/VFR Mode C Intruder) have been developed. Testing of these functions is continuing. Implementation of these functions requires the added computing capacity of host computers.

Enhancements are also being provided for EARTS locations. A contract, which provides radar data mosaicking and conflict alert/minimum safe altitude warning, has been awarded.

Automated assistance for oceanic ATC is also being developed. A contract has been awarded for oceanic display and planning systems which will allow controllers to assign fuel-efficient routes and altitudes.

Also, during this period the agency began to improve and expand the automated interfaces between en route and terminal facilities. New flight data equipment was installed and tested at the Technical Center. The capability of the backup direct access radar channel (DARC) is being expanded through a contract awarded in 1982 to provide radar tracking, automatic track initiation, mosaicking, full data information tags and individual display switching. This eliminates the need to use plastic markers (shrimp boats), adjust displays to a horizontal position, and switch six displays at one time to the backup channel as was the case. A contract for additional software improvements, which provides two way communications with the prime channel computer has been awarded.

The 9020 central flow control complex has been replaced with an IBM 4341 computer with improved software. Traffic management units within the centers are being automated and the operational work stations at the ATC Command Center upgraded. The manual Central Altitude Reservation Function (CARF) and Airport Reservation Function (ARF) will also be automated at that time.

To further expedite the movement of traffic, 15 nonradar control facilities have been integrated into existing radar facilities.

The project to replace cables, printed circuit boards, and medium-speed printers associated with the 9020 system has been completed.

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Progress on these initial efforts has enabled the air traffic control system to handle the growth in traffic that has occurred during this period.

NEAR TERM (TO 1990)

During this period, the 9020s will be replaced by host computers. New flight data equipment will be installed at the first centers and TRACONs to improve flight data transfers. Software enhancements improving system safety and fuel efficiency will be implemented. Enhanced safety levels will result through the implementation of IFR/VFR conflict alert and conflict resolution advisory software on the host computers. The implementation of new en route metering capabilities will further reduce delays and allow for optimized fuel-descent profiles.

Two VSCS prototype system contracts were awarded in early FY-87. A VSCS production contract that will meet the stringent requirements of an ATC voice communications system and, at the same time reduce lease service costs, will be awarded. AERA-2 functional specifications were completed in early FY-86. Laboratory research and development activities investigating performance and operational applications of AERA-2 will continue during this period.

Several significant AAS activities occur during this phase, including completion of design competition, awarding of system acquisition contract and completion of critical design reviews.

The foundation for transition to full AAS will have been provided. This step will prepare the way for additional integration of terminal and en route functions within area control facilities and for higher levels of automation when the full AAS is implemented in the 1990s.

The DARC enhancements that provide radar tracking, mosaicking and individual display switching will be implemented. Implementation of the two-way prime channel/E-DARC communication interface will begin. EARTS radar data mosaicking and CA/MSAW enhancements that will further improve safety and increase capacity will be completed. System improvements provided by ODAPS, and the replacement of flight data entry and printout devices will become operational and reduce FAA and user costs. An offshore flight data processing system (OFDPS), consisting of modern data processing equipment and associated adapted software, will be procured and installed in the Honolulu ARTCC. Four more non-radar approach control locations will be integrated into radar facilities. These activities will result in real time data processing, improved system reliability, and increased system capacity.

Construction, rehabilitation, and plant modernization of ARTCCs and ACFs will provide for heating and air conditioning replacements, upgraded electrical systems, compliance with Occupational Safety and Health Administration (OSHA) regulations, energy conservation, and improvements to security and roads.

The IBM 4341 central flow control computer will be replaced with a new computer to provide capacity to process significantly upgraded flow management functions and to provide capability to handle software enhancements to the mid 1990s. When implemented, newly developed software will enhance the ability to project and estimate NAS traffic congestion and delay levels; provide this information to users; and evaluate alternate flow management strategies based on: arrival/departure messages, capacity estimates from major terminals, data input from the flight service data processing system (FSDPS) on VFR flight plans, and input from the aviation weather processor (AWP) for national weather information.

A foundation for greater Government and user efficiency will be provided. The future capabilities enabled by the advanced automation system will allow the expanded use of area navigation, rapid dissemination of control information, improved flight planning, and oceanic probes.

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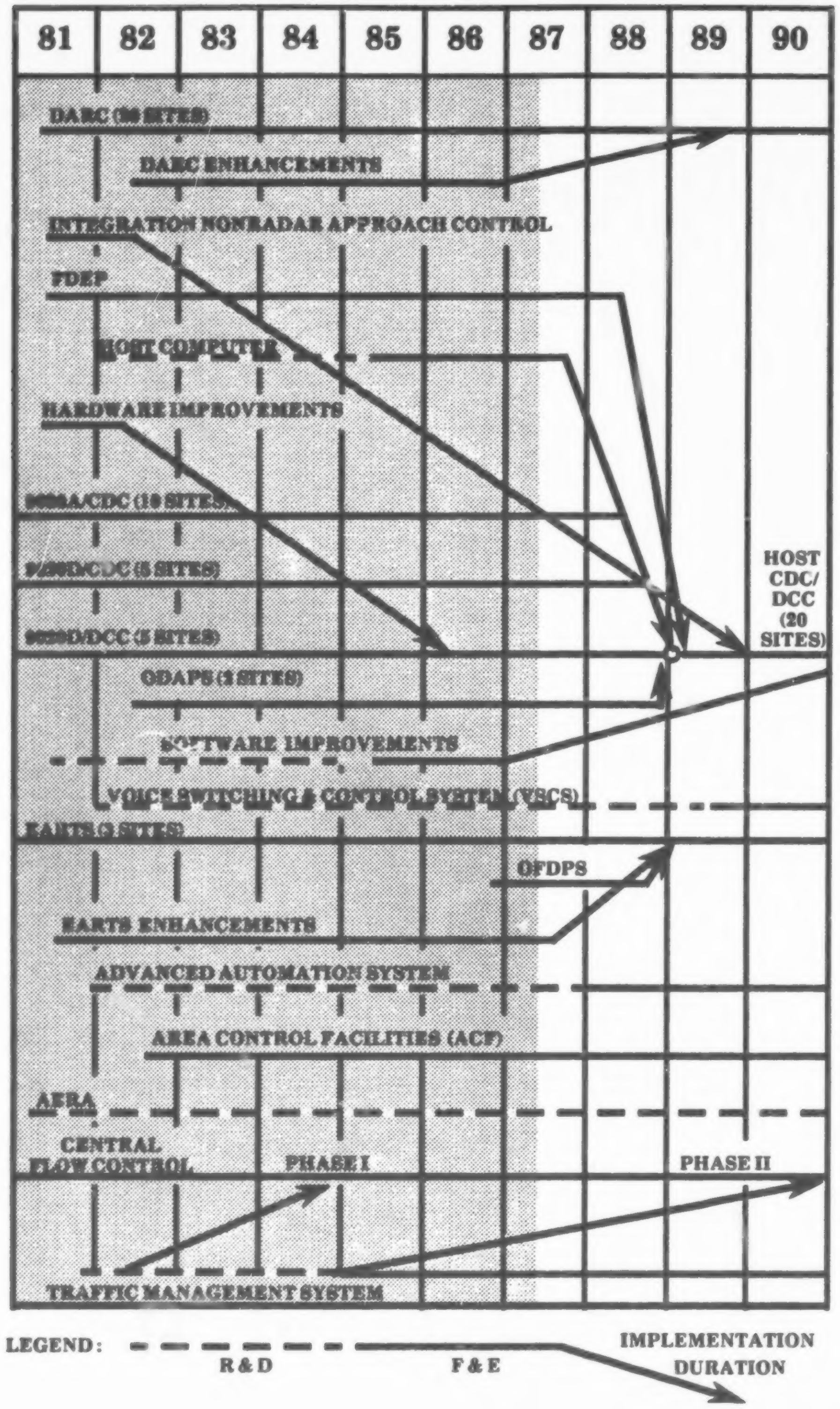
LONG TERM (TO 2000)

By the year 2000, a system wide advanced automated en route air traffic control system will be operational and the consolidation of TRACONs into area control facilities will be complete. The intial sector suite functional capabilities, coupled with the VSCS, will improve controller productivity and reduce lease service costs. Installation of the advanced automation system computers will provide the foundation for the terminal advanced automation (TAA) function which will perform TRACON operations from ARTCCs. Implementation of the area control computer complex (ACCC) function will set the stage for the operational usage of automated en route air traffic control and Mode S data link communications. Tower control computer complexes will be installed and the area control facility concept will become a reality. Also during this period, an advanced TMS, which will perform all national level traffic management functions, will be integrated with the AAS. This fully integrated system will improve traffic efficiency, minimize delays and be more responsive to user requirements.

Services provided by this country's future air traffic control system will be significantly better and more cost-effective. System reliability will be much higher. The increased use of automation will significantly improve both safety and efficiency. Introduction of more advanced automation functions into the system will result in even greater fuel savings.



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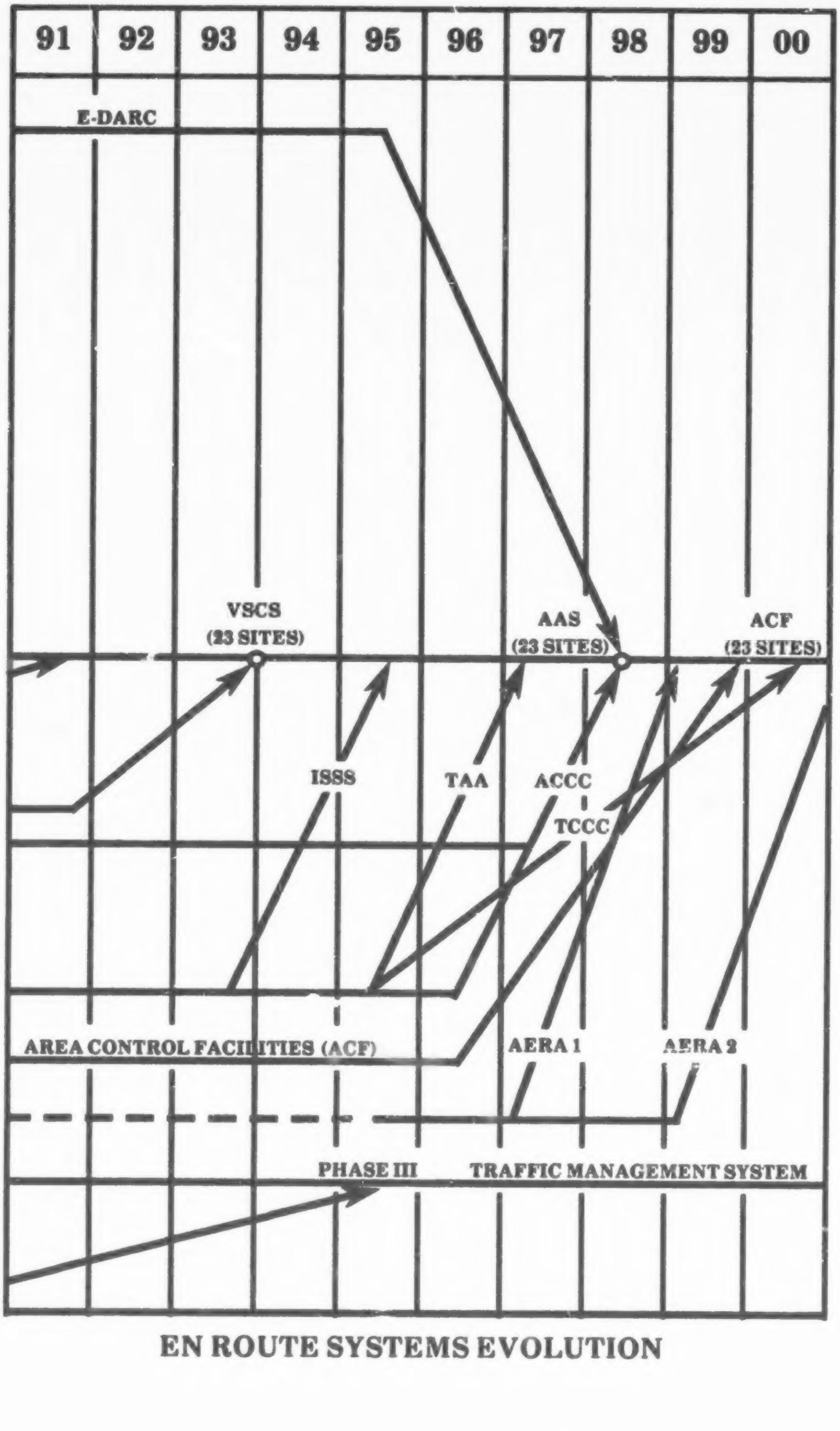
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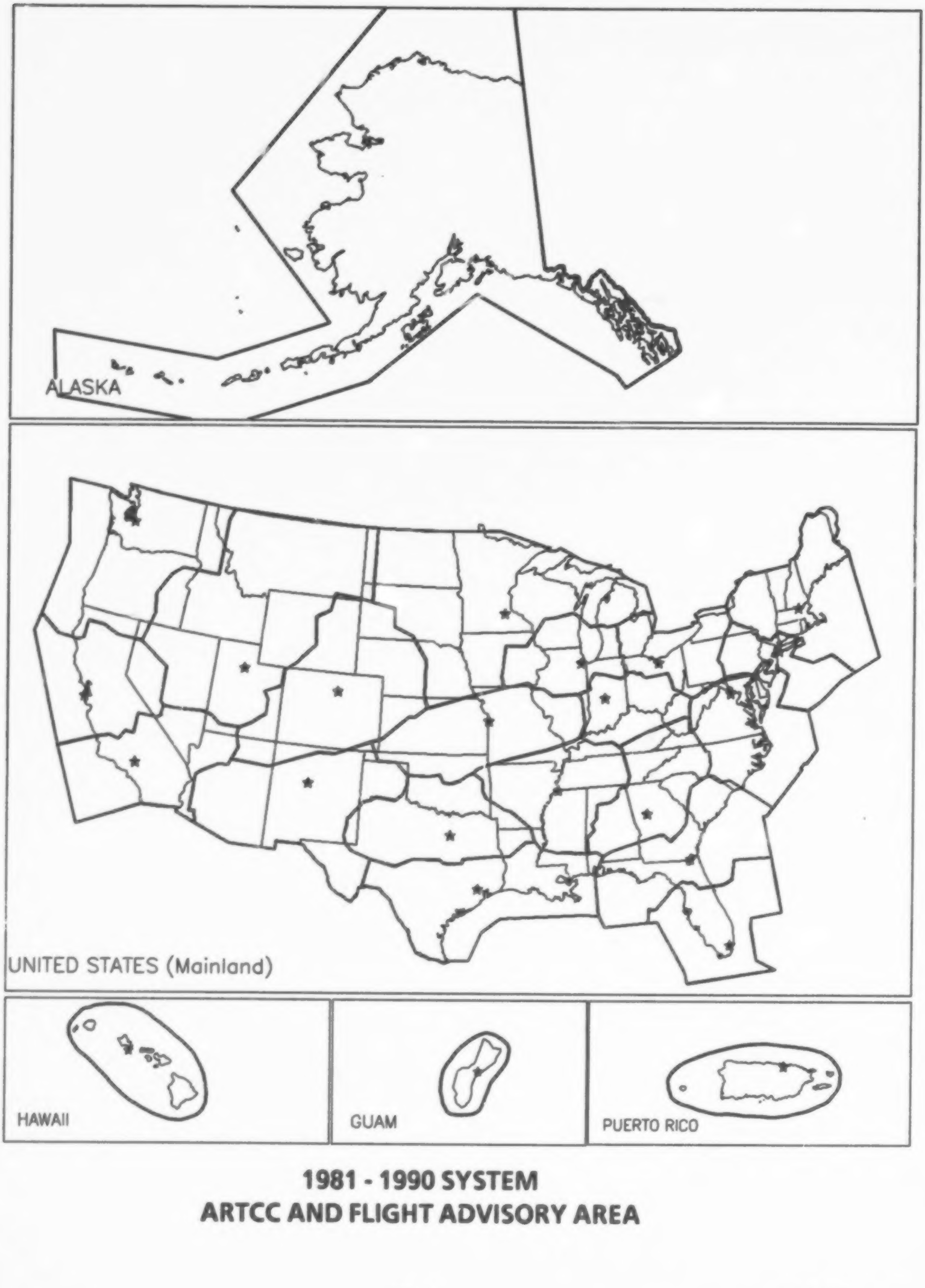
E-DARC
VSCS
(23 SITES)
AAS
(23 SITES)
ACF
(23 SITES)
ISSS
TAA
ACCC
TCCC
AREA CONTROL FACILITIES (ACF)
AERA 1
AERA 2
PHASE III
TRAFFIC MANAGEMENT SYSTEM

EN ROUTE SYSTEMS EVOLUTION

73

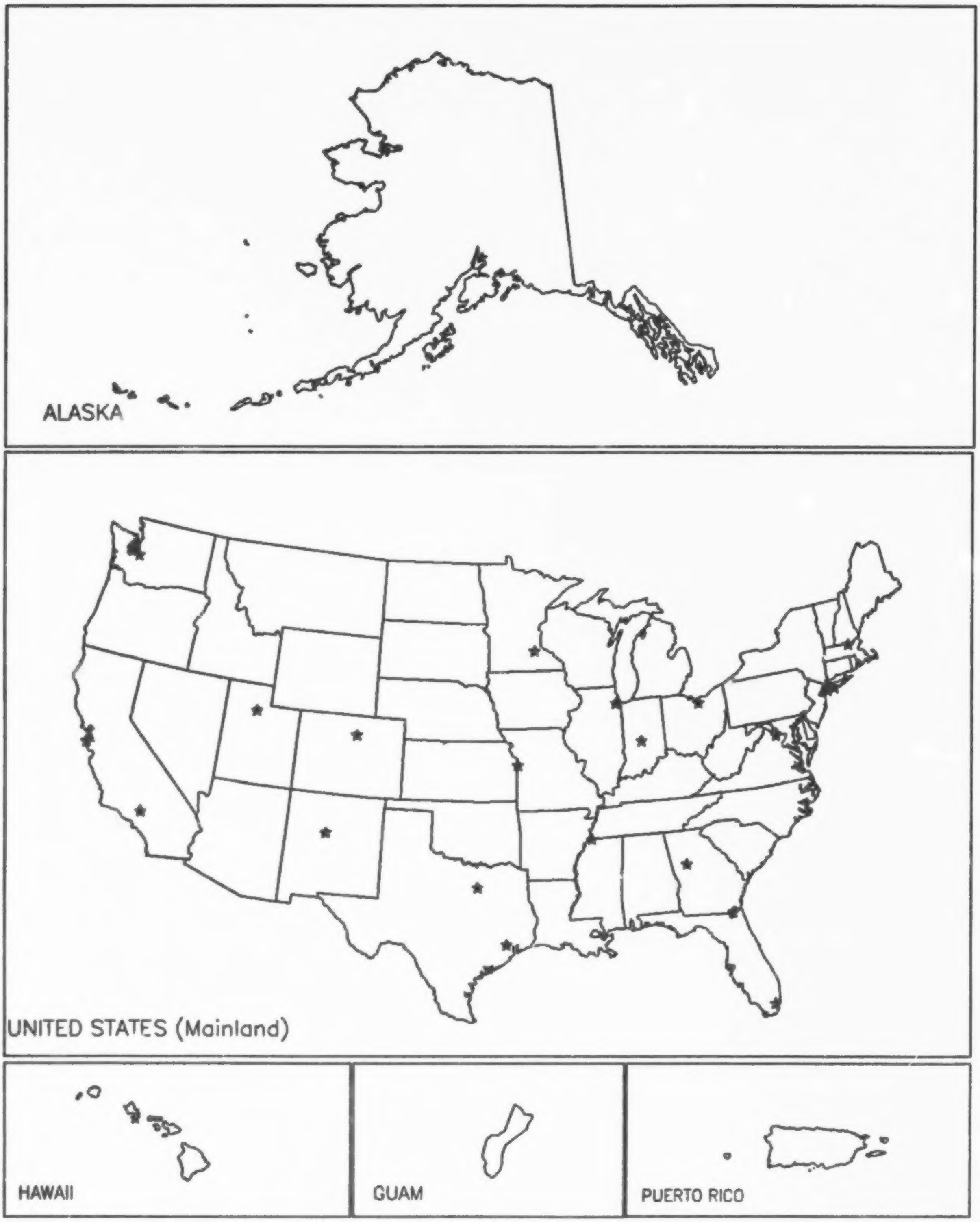
IN 1981, 20 CONTIGUOUS UNITED STATES (CONUS) AIR ROUTE TRAFFIC CONTROL CENTERS AND FIVE OFFSHORE CENTERS SUPPORTED U.S. DOMESTIC AIRSPACE. IN THE SPRING OF 1983 THE PANAMA CERAP WAS TURNED OVER TO THE PANAMANIAN GOVERNMENT. TODAY, THERE ARE 20 CONUS CENTERS, AND CENTERS LOCATED IN ALASKA, HAWAII, PUERTO RICO, AND GUAM.

—	FLIGHT ADVISORY AREAS
★	AIR ROUTE TRAFFIC CONTROL CENTERS (ARTCC)


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1981 - 1990 SYSTEM
ARTCC AND FLIGHT ADVISORY AREA

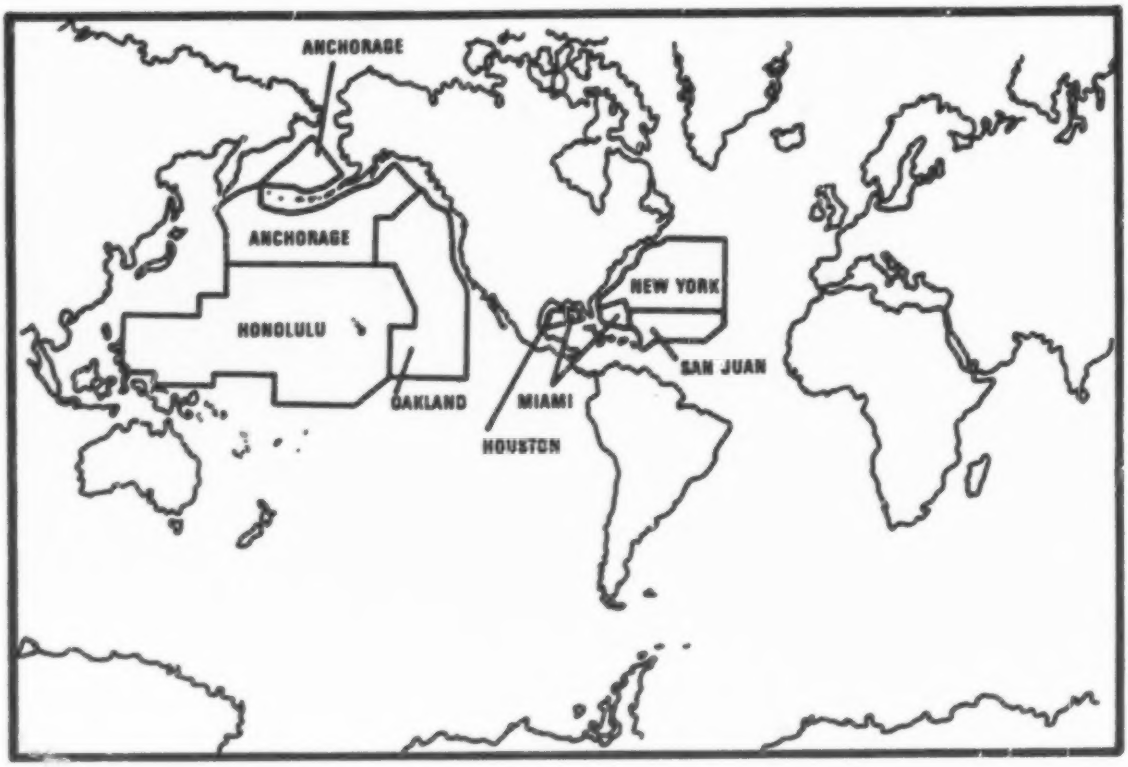
BY THE YEAR 2000, 21 CONTIGUOUS AREA CONTROL FACILITIES AND 2 OFFSHORE ACFs WILL SUPPORT BOTH EN ROUTE AND TERMINAL FUNCTIONS. LOCATIONS MAY CHANGE AS PLANS CONTINUE TO DEVELOP.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

**2000 SYSTEM
AREA CONTROL FACILITIES**

77

BETWEEN 1981 AND 1984, SEVEN AIR ROUTE TRAFFIC CONTROL CENTERS SUPPORTED OCEANIC FLIGHT IN U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS.



ANCHORAGE
ANCHORAGE
HONOLULU
OAKLAND
HOUSTON
MIAMI
NEW YORK
SAN JUAN

SEVEN CENTERS SUPPORTING U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS

1981 - 1984 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

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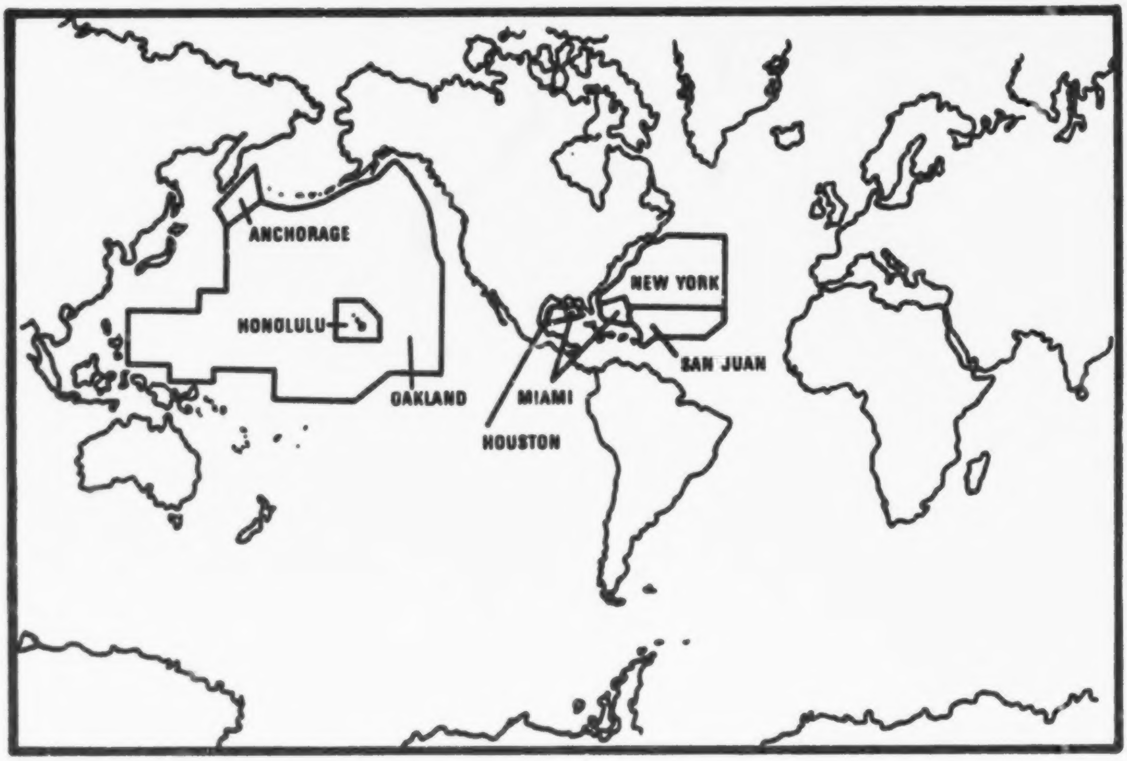
IN 1985, THE GEOGRAPHIC AREA CONTROLLED BY EACH OF THE SEVEN ARTCCs WAS REALIGNED TO MAXIMIZE PRODUCTIVITY AND TO PROVIDE FOR IMPLEMENTATION OF THE OCEANIC DISPLAY AND PLANNING SYSTEM.



ANCHORAGE
HONOLULU
OAKLAND
HOUSTON
MIAMI
NEW YORK
SAN JUAN

SEVEN CENTERS SUPPORTING U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS

1985 - 1986 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

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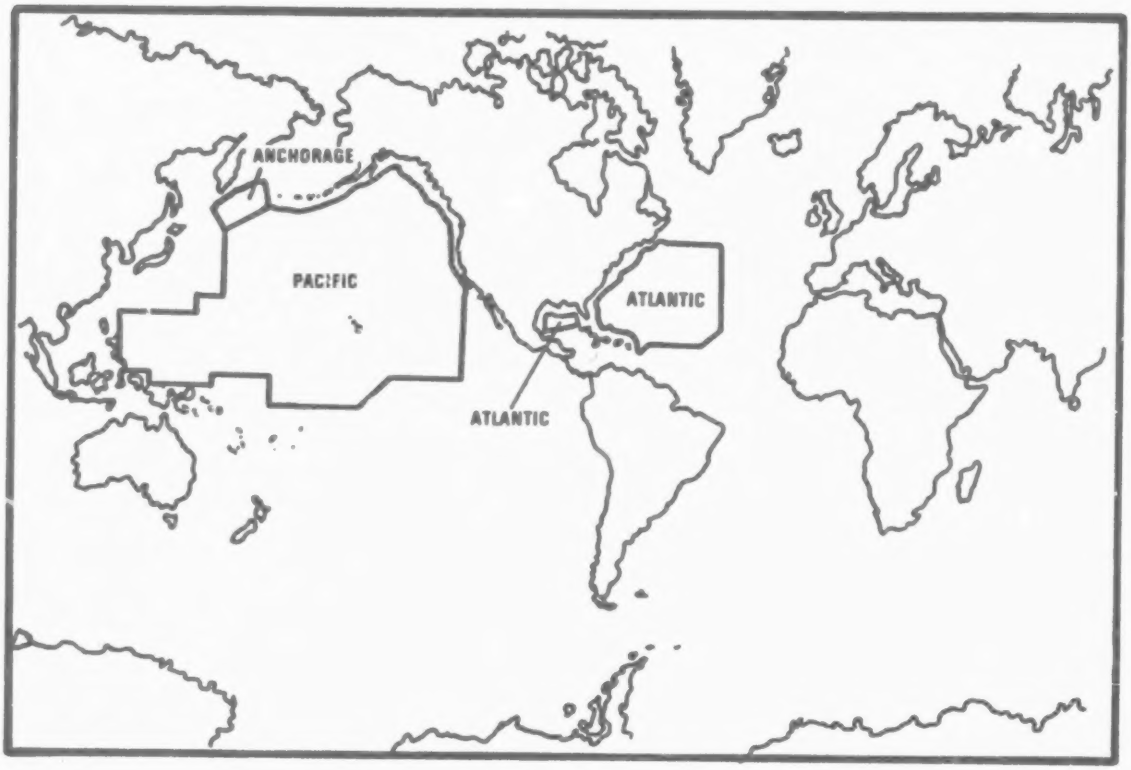
DURING THE PERIOD 1987-2000, THREE AIR ROUTE TRAFFIC CONTROL CENTERS WILL SUPPORT U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS. OCEANIC DISPLAY AND PLANNING SYSTEMS FOR ATLANTIC AND PACIFIC OPERATIONS WILL BE DEPLOYED PRIOR TO THE INTRODUCTION OF AAS.


ANCHORAGE
PACIFIC
ATLANTIC
ATLANTIC

THREE CENTERS SUPPORTING U.S. CONTROLLED INTERNATIONAL FLIGHT INFORMATION REGIONS (LOCATIONS MAY CHANGE AS PLANS CONTINUE DEVELOPMENT)

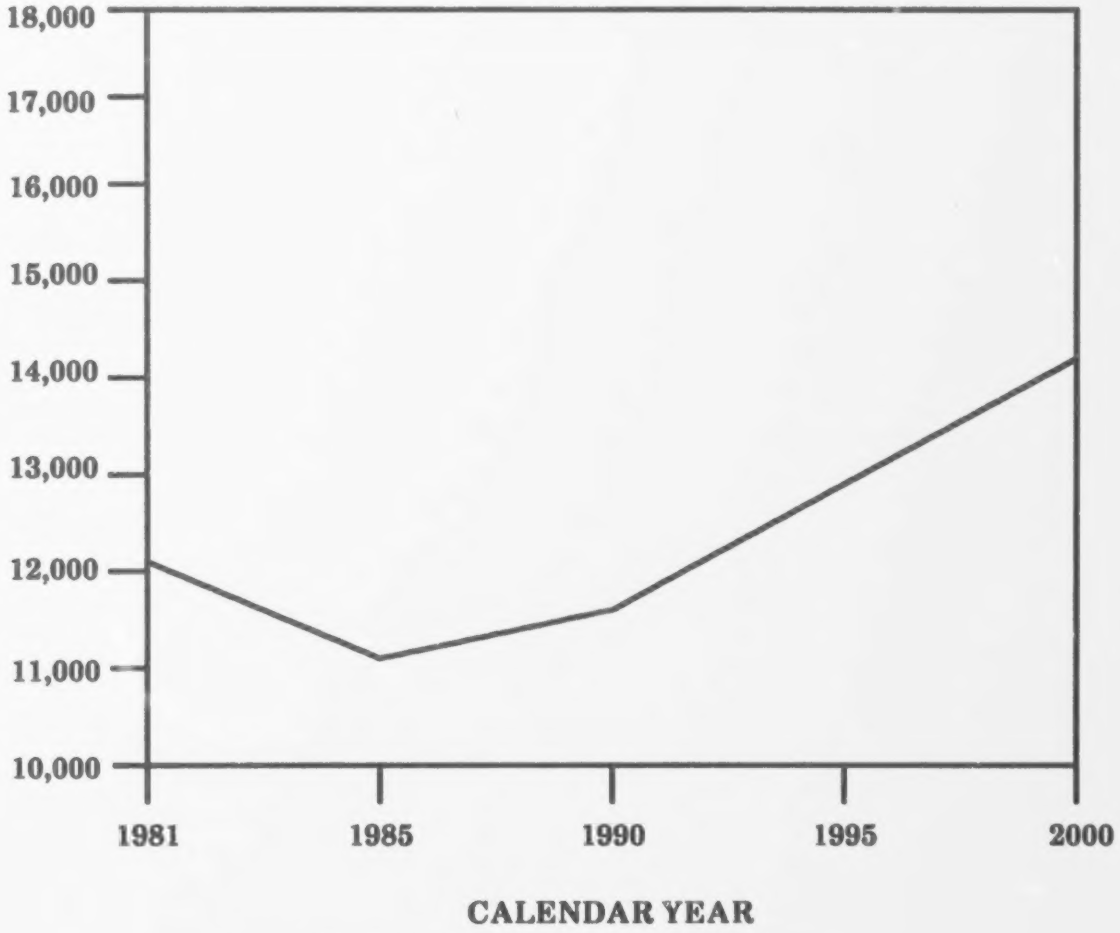
1987 - 2000 SYSTEM
INTERNATIONAL FLIGHT INFORMATION REGIONS (FIR)

RETURN ON THE INVESTMENT

As a result of these planned actions, an upgraded air traffic control system will have been implemented. This will serve as the basis for significant improvements in air safety and will provide the reliability and flexibility necessary for further automation. These system improvements will allow for reductions in maintenance staffing and a slower growth in the number of air traffic controllers than would otherwise occur.

FIELD EMPLOYMENT

During the next 13 years, the en route system will undergo numerous changes in hardware, software, and plant improvements. These changes will affect both Air Traffic and Airway Facilities employment as shown in the chart below:



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(EN ROUTE/ACF SYSTEMS)

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SUMMARY OF FACILITY CHANGES

1981–Airway Facilities (AF) and Air Traffic (AT) employment required a total of 12,124 people.

1985–Air Traffic employment decreased to 9,125 principally because of reductions made possible by enhancing the direct access radar channel (DARC) and resectoring en route airspace. A total AT and AF work force of 11,109 was required to operate and support facilities.

1990–Airway Facilities employment will decrease due to the replacement of the central computer complex and other equipment within the ARTCC.

2000–Air Traffic employment is estimated to increase to 12,520. This apparent increase, however, is offset by the decrease in employees previously required for terminal radar approach controls (TRACON). The total AT employment for en route and terminal facilities will actually decrease from 20,150 (in 1990) to 17,290 due to consolidation of terminal and enroute operations into area control facilities and the capabilities of advanced automation.

Outyear estimates are reviewed annually and are subject to revision.

EN ROUTE/ACF SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS

	1981	1985	1990	2000
Operations (Millions)	27.3	32.7	38.7	47.2
Air Traffic Personnel	10,300	9,125	9,990	12,520
AT Productivity Quotient	2,650	3,584	3,874	3,743
Airway Facilities Personnel	1,824	1,984	1,644	1,508
AF Productivity Quotient	14,967	16,482	23,540	31,300
Total AT & AF Staffing	12,124	11,109	11,634	14,118
Air Traffic Personnel Costs (Thousands)	$368,740	$326,675	$357,642	$420,766
Airway Facilities Personnel Costs (Thousands)	$62,198	$67,654	$56,060	$51,423

PROGRAM RELATIONSHIPS

The objective of the NAS Plan is the creation of a fully integrated air traffic control and navigation system capable of meeting the capacity, efficiency, and air safety demands anticipated by the turn of the century. Its projects are interrelated.

Implementation of the advanced automation system and area control facilities, described in this section of the Plan, will bring about major changes in the methodology and hardware used in the terminal environment. In the mid-1990s, the radar approach control facilities will begin to be consolidated into area control facilities supported by standardized equipment. New tower control computer complexes (the terminal component of the advanced automation system) will be installed in towers. The AAS will integrate en route and terminal air traffic control by providing full access to traffic, flight, and weather data bases available in ACFs.

The Flight Service and Weather Systems portion of the Plan contains improvements required to modernize flight and weather services which also affect en route system performance. Foremost among them, the central weather processor provides improved weather products for ACF operations. Moreover, guidance, surveillance, weather, and communications aids must receive upgrades and service improvements (as described in Chapter IV) to optimize system performance or provide the foundation for service improvement through the next decade.

Projects in Chapter V, Interfacility Communications Systems, improve the reliability, efficiency, and cost-effectiveness of communicating digital and voice information between towers, ACFs, and remote facilities. This chapter also implements television microwave links needed to provide radar data to satellite towers.

Chapter VI, Maintenance and Operations Support Systems, describes improvements to maintenance, flight inspection, and overall system support of the NAS.

The projects in this section form a unified 3-phase approach that has maintained reliable service, will improve services in the near term, and modernize service in the long term. Initial efforts included En Route Automation Hardware Improvements and Enhancements, and the first phase of the Traffic Management System; these resolved immediate problems, and allowed an evolutionary approach to service improvement. Near-term projects will provide for service improvements in continental, offshore, and oceanic airspace.

Individual but related improvements in continental services are derived from the implementation of modern ATC host computer and dependent software enhancements (en route metering, and conflict alert IFR/VFR Mode C intruder), flight data entry and printout devices replacement, enhanced DARC, and the second phase of traffic management system improvement. Improvement in offshore services is derived from EARTS enhancements and an offshore flight data processing system. Oceanic services are improved by ODAPS.

Modernization of the air traffic control system will occur with the establishment of area control facilities (ACF) and the implementation of automated en route air traffic control (AERA). The capabilities of the advanced automation system (AAS) and the voice switching and control system are required to establish ACFs and execute AERA functions. Enhanced DARC and the host computer are required to transition to the AAS.

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PROJECTS	IMPLEMENTATION	
	FIRST	LAST
1. En Route Automation Hardware Improvements and Enhancements	PROJECT	COMPLETE
2. Flight Data Entry and Printout Devices	1988	1989
3. Direct Access Radar Channel (DARC) System	1986	1989
4. EARTS Enhancements	1987	1989
5. Oceanic Display and Planning System (ODAPS)	1988	1988
6. Traffic Management System (TMS)	1982	1995
7. Modern ATC Host Computer	1987	1989
8. En Route Metering (ERM)	COMBINED	WITH TMS
9. Conflict Resolution Advisory Function (CRA)	1990	1991
10. Conflict Alert IFR/VFR Mode C Intruder	1986	1989
11. Voice Switching and Control System (VSCS)	1991	1993
12. Advanced Automation System (AAS)	1993	1998
13. Automated En Route Air Traffic Control (AERA)	1997	2001
14. Integration of Nonradar Approach Control into Radar Facilities	1982	1989
15. Area Control Facilities (ACF)	1996	1999
16. Offshore Flight Data Processing System (OFDPS)	1989	1989

PROJECT SUMMARY

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PROJECT 2: Flight Data Entry and Printout Devices

Purpose: The flight data input/output (FDIO) project will replace the existing flight data entry and printout (FDEP) and en route flight strip printer (FSP) systems and establish FDIOs at additional airport locations. Replacements will result in a reduction in manpower-intensive equipment and in a savings of up to $3 million a year. New establishments allow the automatic exchange of flight data with the air route traffic control centers over telephone lines. Automatic exchange is a vast improvement over manual exchange which is time-consuming, can cause delays to air traffic, and can create the potential for human error because the flight plan information is copied by hand. New establishments will result in a reduction in overall manpower (operators and technicians) costs up to $6 million a year.

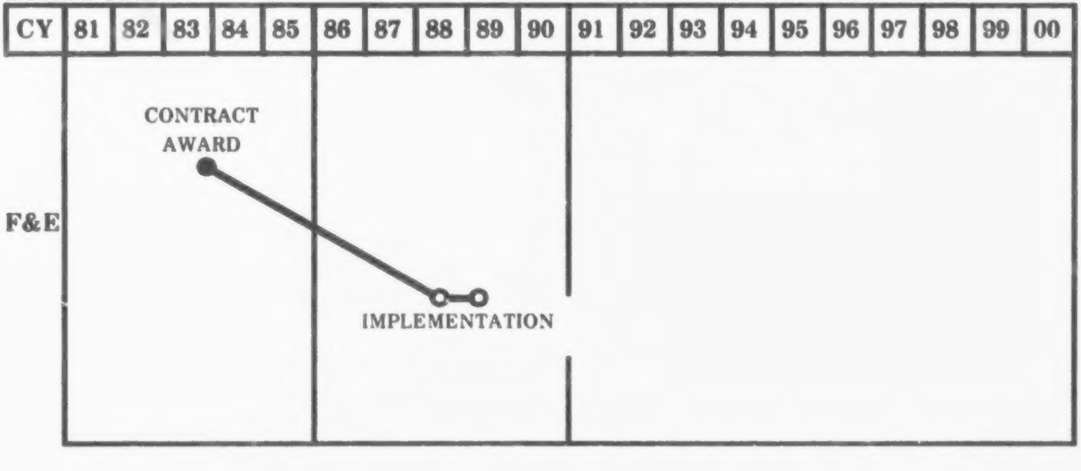
Approach: A basic contract with multi-year delivery requirements has been awarded. Critical design review was completed in FY-84 and equipment deliveries began in 1986. The FDIO program consists of ARTCC systems, systems for the FAA Academy and the FAA Technical Center, 318 remote systems, spare parts, documentation, engineering support services, implementation plans, and test procedures. Possible requirements for additional equipment, training, and automated NAS documentation may necessitate future-year procurements. A rewrite of a portion of the host software will be necessary to utilize the general purpose output/general purpose input (GPO/GPI) adapters in lieu of the FDEP adapters currently used. The software will be required to process both old and new systems simultaneously during FDIO implementation.

Products: The program includes the replacement of flight strip printers at 23 ARTCCs, the FAA Technical Center, and the FAA Academy and the replacement of FDEP systems and establishment of new FDIO systems at 318 ATCT/TRACONs, 108 military terminals, the FAA Academy and the FAA Technical Center; establishment of FDIO systems at 2 ARTCCs and the FAA Technical Center for the oceanic display and planning system. System components currently identified in the contract include the following:

Flight Strip Printers	2499
Keyboards	969
Displays	768

Related Projects/Activities: OFDPS, ODAPS and ATCT/ TRACON Relocation, Modernization, and Establishment all require the new FDIO devices. Software implementation in the host computer is required for interface with the FDIO system. The FAA with contractor support will modify the host software to accommodate FDIO. DOD interfaces and requirements are included in the FAA's contract. This project will require interfacility communications service from NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing.

SCHEDULE



PROJECT 3: Direct Access Radar Channel (DARC) System

Purpose: The current DARC system was in place in all 9020 ARTCCs in June 1981. The enhanced DARC (E-DARC) will upgrade the backup system to look and function in a similar manner to the prime channel computer. E-DARC will provide tracking, mosaicking, and real-time quality control and will allow each controller to select either mode of operation, prime channel computer or E-DARC, at his radar console. E-DARC enhances the safe and orderly transition from prime channel operation. From the controllers' viewpoint, E-DARC will eliminate the use of mechanical radar target markers and the need to move the plan view display (PVD) to the horizontal position.

Approach: A contract for the first phase of the E-DARC system enhancements was awarded in early 1982 and provided for the development, production, documentation, installation, and test of three turnkey systems. The remaining systems were installed and tested by FAA personnel in FY-86.

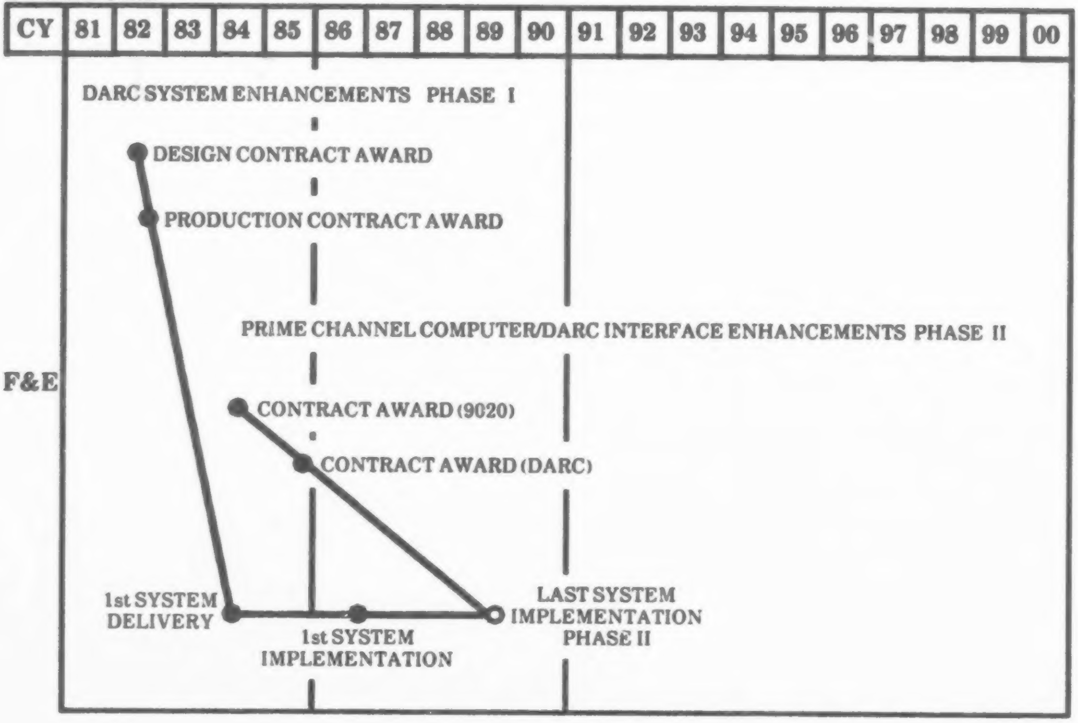
The E-DARC modifications include system analysis recorders (SAR) for post air traffic incident review, doubling memory and processing power by adding plug compatible metal-oxide semiconductor (MOS) memory and microcomputer boards, tracking, automatic track initiation, mosaicking, and real time quality control. Additionally, modified display generator input/output boards, cable harnesses for individual PVD switching capability, and fully automatic display processor and generator sparing were provided. Software delivered and tested by the contractor at the FAA Technical Center and FAA Academy has been baselined and distributed to a selected ARTCC for key-site testing. Subsequent to key-site testing, software was delivered to the remaining ARTCCs in early 1987.

With the implementation of E-DARC Phase II, tracks will be automatically initiated using flight plan related data received from the prime channel computer via a communications interface between the prime channel computer and E-DARC. If the prime channel computer becomes nonoperational, E-DARC will continue to track and display full data blocks. A contract for the prime channel computer software modifications was awarded in FY-84 and a similar contract for the E-DARC software modifications was awarded in early FY-86. The implementation of the prime channel computer modifications will allow a more transparent transition to E-DARC operation if the prime channel fails. Two-way prime channel computer/E-DARC interface software will be available for inclusion in revisions to the host software.

Products: 22 E-DARC systems -- 20 for ARTCC, 1 for FAA Technical Center, and 1 for FAA Academy. Prime channel computer/E-DARC interface software.

Related Projects/Activities: Host, ISSS, and AAS. The E-DARC will provide backup for periods of transition to Host, ISSS and AAS. E-DARC will be removed once AAS is operational. Improved weather display capability will require DARC software modification.

SCHEDULE



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DARC SYSTEM ENHANCEMENTS PHASE I
DESIGN CONTRACT AWARD
PRODUCTION CONTRACT AWARD
PRIME CHANNEL COMPUTER/DARC INTERFACE ENHANCEMENTS PHASE II
F&E
CONTRACT AWARD (9020)
CONTRACT AWARD (DARC)
1st SYSTEM DELIVERY
1st SYSTEM IMPLEMENTATION
LAST SYSTEM IMPLEMENTATION PHASE II

PROJECT 4: EARTS Enhancements

Purpose: This project will enhance air safety and increase ATC system capacity by providing radar data mosaicking, conflict alert, and minimum safe altitude warning for EARTS.

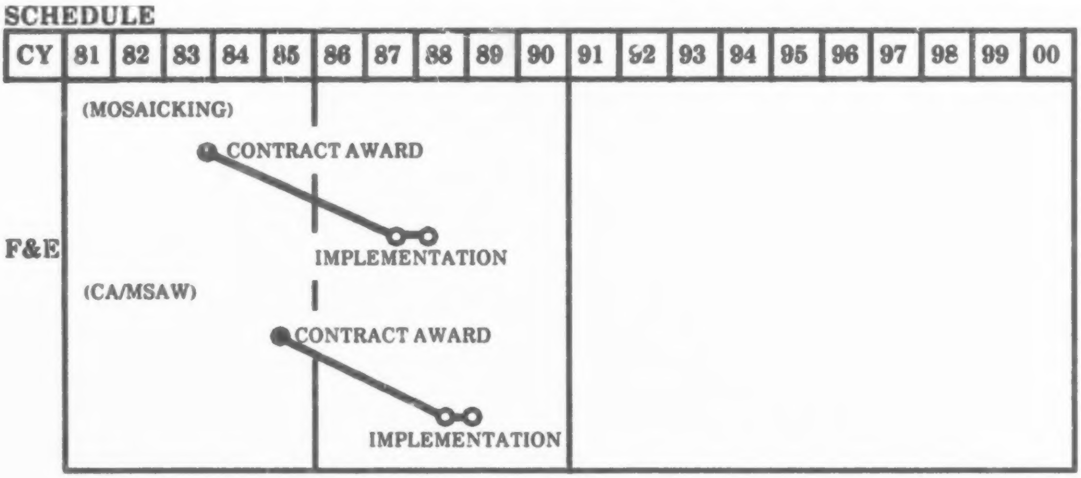
Increased radar coverage allows more efficient use of airspace and reduces fuel consumption. The mosaicking of radar data in EARTS will allow reconfiguring of the sectors at offshore centers resulting in improved controller workload distribution. For FAA to utilize the USAF's minimally attended radar (MAR) fully in Alaska, changes and additions to the EARTS hardware and software are necessary to interface and accept the MAR generated digital target reports and status messages.

Conflict alert (CA) and minimum safe altitude warning (MSAW) capabilities will be provided to alert air traffic control personnel to potential hazardous in-flight conditions where less than standard separation exists between aircraft, aircraft and the ground, or aircraft and ground obstructions.

Approach: As the USAF's Alaskan Air Command updates and provides narrowband data from its long-range radars back to Anchorage, this data (search and/or beacon) will be provided to the Anchorage ARTCC. EARTS will be expanded and upgraded to utilize and display this data effectively; i.e., consoles, reformatters, processors, and mosaic software will be added. For software maintainability, the EARTS mosaic software will also be delivered to Honolulu, San Juan, and Nellis Air Force Base beginning in FY-87. CA and MSAW software and hardware changes will then be added. A contract for providing the CA and MSAW features was awarded in mid-FY-85 with deliveries expected to begin in FY-88.

Products: Four upgraded operational EARTS.

Related Projects/Activities: The advanced automation system will replace the EARTS systems at FAA locations. FAA must also incorporate modifications to the affected MAR units to improve beacon target resolution performance. This project will require interfacility communications service from NICS. The Data Multiplexing project will provide additional transmission network savings. Installation of the Offshore Flight Data Processing System in 1989 will provide improved flight data processing in the Honolulu ARTCC.



PROJECT 5: Oceanic Display and Planning System (ODAPS)

Purpose: ODAPS provides automation assistance for oceanic ATC. Included is an automated conflict probe which will assist controllers in assigning more fuel-efficient routes and altitudes. These fuel savings will be realized without adverse impact on the ATC system.

The current use of random tracks, inefficient flight data posting, and unstructured traffic flow in the oceanic flight information regions (FIR) limit aircraft use of fuel-efficient altitudes. Oceanic controllers confronted with an increasing number of random flight tracks are not able to visualize the spatial relationships of aircraft from data presented on flight progress strips or plotting boards. The maintenance of the strip and board displays and the methods for transfer of flight data are labor-intensive and antiquated. The major advancement made in the oceanic air traffic control system during the past 30 years has been the automated printing of flight progress strips.

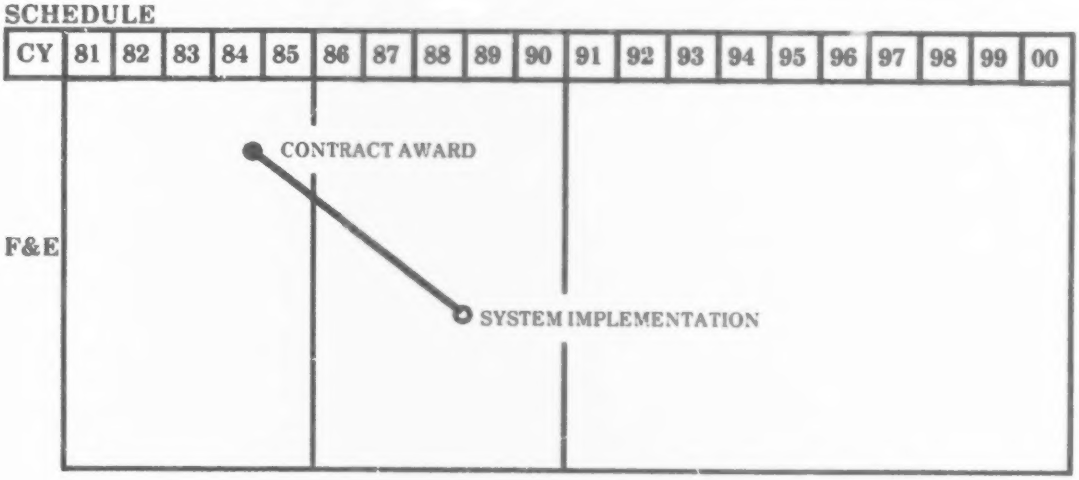
The new system will compare the planned tracks and altitudes of different aircraft and inform the controller whether the cruising altitude or route is free from potential conflicts and when transitions can be made. This function will allow controllers to honor more flight profile requests and create a safer and more efficient environment in oceanic airspace.

Approach: Provide oceanic automation systems comprised of situation displays, processors, and interfaces with other ATC systems, including ARINC high frequency (HF) data. The system will operate until the advanced automation system is implemented.

Products: In early FY-85, a contract was awarded for the procurement and implementation of 3 ODAPS -- 2 operational sites and 1 at the FAA Technical Center. Delivery to the FAA Technical Center is planned for FY-88.

Related Projects/Activities:

- FDIO - used for ODAPS flight data entry and display and an integral part of ODAPS.
- NADIN - will provide specific communications services.
- AAS - will include requirements for oceanic automation.
- Modern ATC Host Computer - host monitor software will be modified for use in ODAPS.
- OFDPS - will communicate flight data with ODAPS to perform the flight data processing function for Honolulu ARTCC.



PROJECT 6: Traffic Management System

Purpose: This project will upgrade the present flow control system into a fully integrated traffic management system (TMS) which will operate at the national level through the Central Flow Control Function (CFCF) at FAA headquarters and the local level through traffic management units (TMU) in each ARTCC and designated level-V terminals. The upgrading of the traffic management system is designed to improve air traffic system efficiency, minimize delays, expand services, and be more responsive to user requirements. Included in the TMS are: Central Altitude Reservation Function (CARF); Airport Reservation Function (ARF); Emergency Operations Facility (EOF); Central Flow Weather Service Unit (CFWSU); various flow management programs with integrated en route metering (ERM) functions, such as the departure sequencing program (DSP), en route spacing program (ESP), and the arrival sequencing program (ASP); and the hardware and software necessary to support them, including performance analysis/evaluation functions.

Approach: The present flow control and altitude reservation system will evolve using a three-phase approach: (1) Phase I completed in FY-84, (2) Phase II completed in FY-91 and (3) Phase III completed in FY-95.

Phase I included:

- Replacement of CFCF 9020A computer system at Jacksonville, Florida, with the IBM 4341 computer located at the FAA Technical Center.
- Relocation of CARF and the automation staff to FAA headquarters.
- Implementation of a data communications system to interface users and NAS 9020 computers at each ARTCC in a two-way data mode interfacility flow control network (IFCN).
- Installation of upgraded data terminals in CFCF.
- Improvement of departure release time software controlled departure times (CDTs).
- Implementation of a static en route sector load software (ELOD) at flight level 240 and above

Phase II focuses on the following areas:

- Implement automated DSP at selected ARTCCs and tower locations.
- Traffic management unit (TMU) automation new computer/terminal systems.
- Rehost central flow control computer (CFCC).
- Implement dynamic ELOD for all en route sectors.
- Estimated departure clearance time (EDCT) software enhancements.
- Establishment of enhanced ATC system graphic capability in CFCF and TMUs.
- Relocation of CARF processors from the development location to FAA Technical Center.
- Establishment of data communications links with user organizations and enhanced capability to monitor equipment status of all operational elements of TMS.
- Color graphics workstations (supplements monochrome displays) hardware and software to be located in the CFCF, FAA Technical Center, TMUs, and EOF to enhance display processing of data and to interface with the CFCC, IFCN and prime channel computer.
- Stand-alone color weather radar displays for the TMUs.

Phase III activities will be divided into three areas: 1) initial activities include a new facility for TMP hardware modifications, computer purchases, new and improved software, and enhancements to the Phase II capabilities; 2) systems engineering, design, development, and implementation of a Traffic Management Processor (TMP) which will perform all national level TMS functions; and, 3) a set of activities to fully integrate the AAS with the TMP. A transition plan will be prepared and maintained to document the TMS Phase III activities and facilitate the transition to AAS. The ERM function (formerly Project 8) will be implemented during Phase III.

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Projected requirements for TMS Phase III are:

- Implementation of integrated ASP, ESP, and DSP automation in the Host computer and TMU workstations.
- Implementation of a Runway Configuration Management System (RCMS) at selected major towers with interfaces to the Host metering functions and demand data.
- Implementation of DSP at selected towers not covered by Phase II DSP implementation.
- Enhancement of the dynamic ELOD capability to estimate sector loading impact due to manually specified trial reroutes.
- Expansion of TMU workstation hardware capabilities to support TMU functions until the transition to AAS sector suites is complete.
- Enhanced performance analysis evaluation and data recording capabilities.
- Transition from the CFCC to the TMP, including consolidation of CARF, ARF, weather analysis, and central flow control functions.
- Flight plan processing to include processing upper wind data.
- Airspace probe to predict aircraft penetration into specified airspaces.
- ACF backup support.
- New color graphics workstations for the CFCF and EOF (including voice communications), similar to that provided by the AAS.
- Near real time flight monitoring and display of IFR flights to determine and resolve saturation problems.

Products: The traffic management system will provide integrated hardware and software that will be highly responsive to existing and projected traffic management situations. It will also assist traffic management personnel in evaluating the impact of various alternatives which may be employed for resolving traffic management situations.

Related Projects/Activities:

- Modern ATC Host Computer - The capacity of the host computer is required for implementing the ERM integrated DSP, ESP, and enhanced ASP automation aids.
- Weather Products - Provided by both the Center Weather Service Units (CWSU via the CWP) and Central Flow Weather Processor (CFWP), respectively) will be used by the TMUs and CFCF to further enhance TMS performance.
- AAS - The central flow control computer and its eventual replacement (the TMP) will interface with the AAS for the exchange of traffic information, as determined in Phase III. AAS will perform local traffic management functions at the completion of Phase III.
- National Radio Communications System - Used in an emergency, it provides complete communications coverage with FAA headquarters, regions, field facilities, and other Government agencies.
- This project will require interfacility communications service from NICS. Projects providing the switching and transmission network include NADIN, RML Replacement and Expansion, and Data Multiplexing.
- AERA - AERA will incorporate and execute the en route metering and delay absorption plans developed in the en route metering project.

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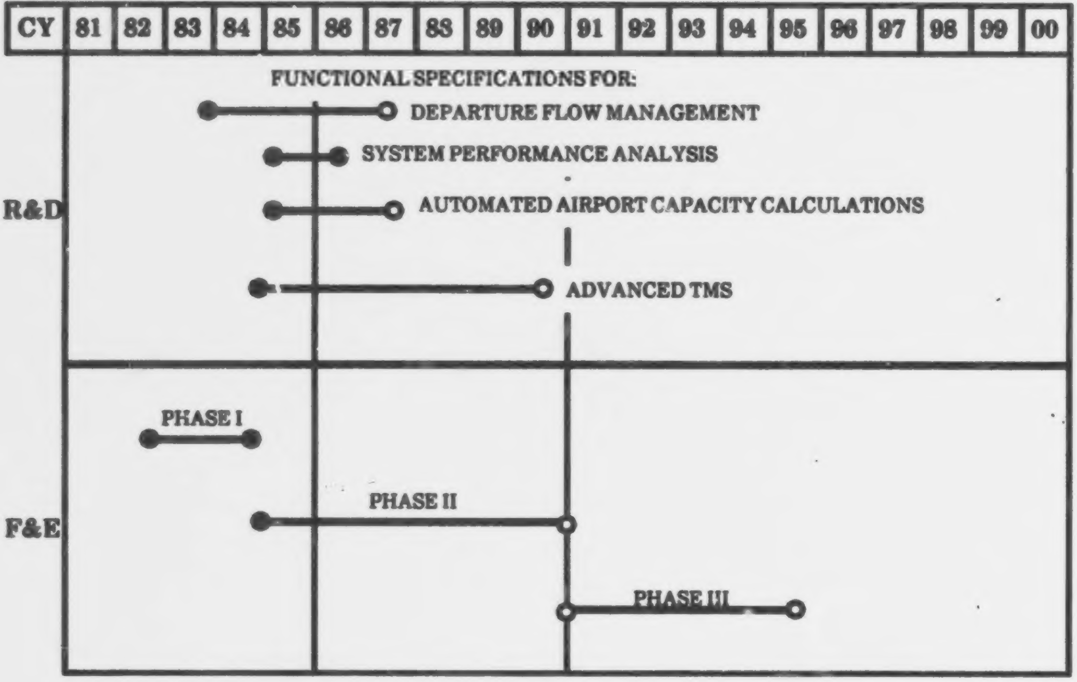
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FUNCTIONAL SPECIFICATIONS FOR:
DEPARTURE FLOW MANAGEMENT
SYSTEM PERFORMANCE ANALYSIS
AUTOMATED AIRPORT CAPACITY CALCULATIONS
ADVANCED TMS
R&D
PHASE I
PHASE II
PHASE III
F&E

PROJECT 7: Modern ATC Host Computer

Purpose: The purpose of the computer modernization project is to provide needed computer capacity for the present en route systems as early as practicable and improve computer reliability and availability. The modernization consists of the implementation of a host computer which is the first step of the advanced automation program. This first step will preclude problems associated with the capacity and capability limits of the current automation system. It is required to support the transition to the future air traffic control system.

Approach: The present IBM 9020 computers will be replaced with instruction-compatible host computers. Minimum changes will be made to the existing en route system software to enable it to run in the host computers. The host computer with en route software has been thoroughly tested at the FAA Technical Center to ensure that it operates correctly and reliably. The computers will be installed in the en route traffic control centers, replacing the 9020 computers, and interfaced with the present display channel systems and peripheral adapter modules. The first computer was installed at the initial operational site, Seattle ARTCC, in late 1986.

The scope of the computer modernization program includes:

- Expansion or modification of the existing ARTCC building to accommodate the host computer and provide space for implementation of the initial sector suite in a sterile environment. That effort commenced in FY-84 and will be completed in FY-87.
- Replacement of all 9020A and D central computers.
- Modification of en route software to operate in the new host computers.

The transitioning of the new host computer into the operational system must not disrupt air traffic control in the en route system. During transition to the host computer, it will be possible to revert back to the 9020 operation in case of extended host failure.

Products: Host computers will be provided for:

- 20 contiguous en route sites.
- 2 support facilities (FAA Technical Center and FAA Academy).
- 2 as government-furnished equipment (GFE) to the advanced automation system contractors (1 to each contractor).
- En route software modified to operate in the new host computers will also be provided.

Related Projects/Activities:

- E-DARC will provide backup for periods of transition to host.
- Software for FDIO, Conflict Alert IFR/VFR Mode C Intruder, ERM, E-DARC and Conflict Resolution Advisory will be incorporated prior to implementation of AAS.
- The implementation of the host computer is the first transitional step in the FAA's plan for full implementation of the advanced automation system and area control facilities.
- The host computer will become an integral part of the initial sector suite system, which is the second transitional step to the full advanced automation system and area control facilities.

This project will require interfacility communications service from NICS. Projects providing the required switching and transmission network service include NADIN and Data Multiplexing.

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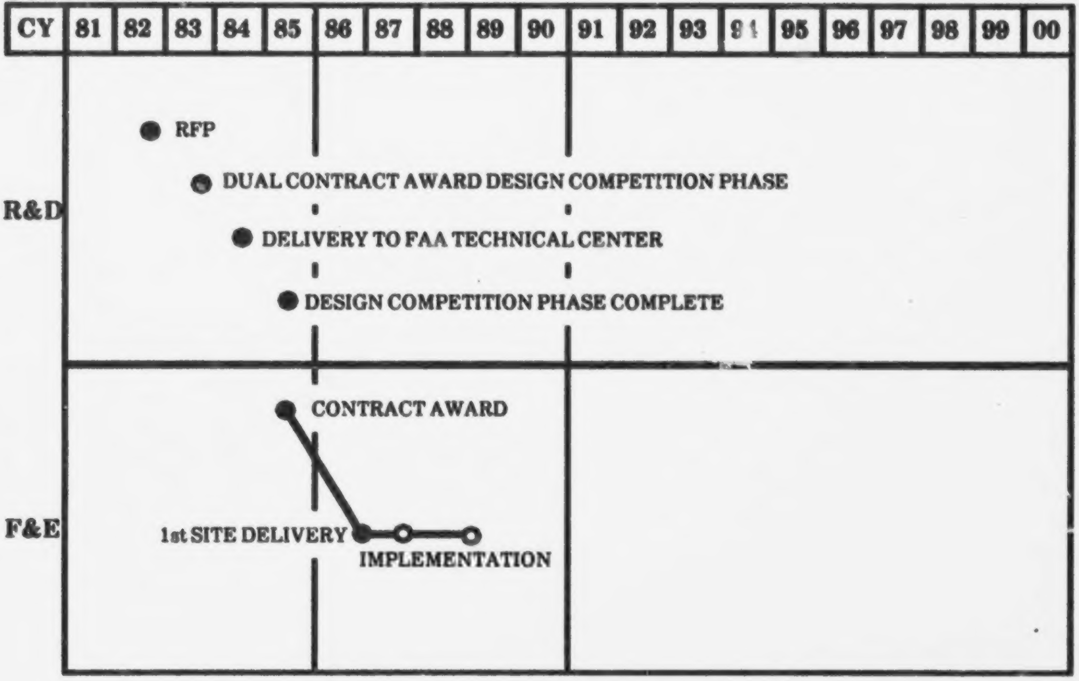
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DELIVERY TO FAA TECHNICAL CENTER
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IMPLEMENTATION

PROJECT 9: Conflict Resolution Advisory Function

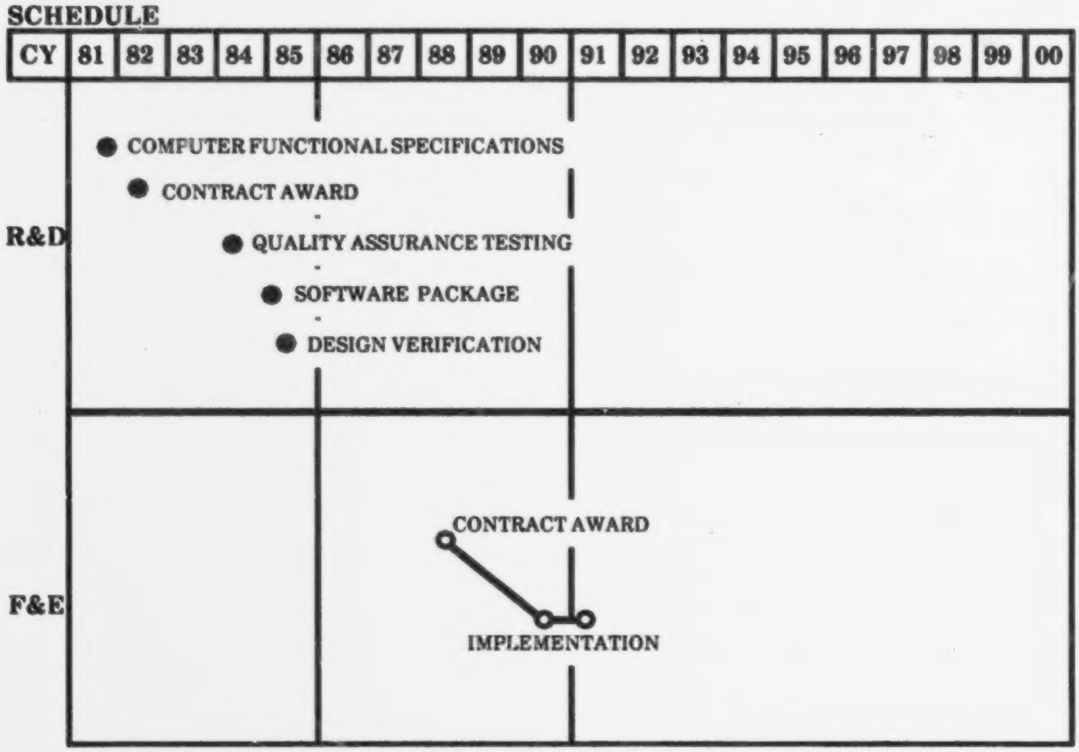
Purpose: This project will provide automation-aided assistance to en route radar controllers in resolving potential conflicts when violation of separation minima is about to occur. The conflict resolution advisory function is designed to provide the radar controller with a display of alternative resolution of conflicts detected by the conflict alert function. The prime objective of conflict resolution advisories is to reduce the number of operational errors (violations of en route separation standards).

Approach: Using functional specifications, a support contractor has designed, programmed and tested a prototype to incorporate the conflict resolution advisory function into the operational en route computer program. Critical design review, integration, and system testing were accomplished in FY-84. Following development, the modified computer program was evaluated in the FAA Technical Center system support laboratory. The modified computer program will be implemented in the host computer beginning in FY-90.

Products: One computer program adaptable for use at 20 host-equipped air route traffic control centers.

Related Projects/Activities: The capacity of the host computer is required before implementation of this software package. Conflict Resolution Advisory implementation is a transitional step toward a similar function in the AAS.

The Conflict Resolution Advisory function will use the output of the Mode C Intruder function.



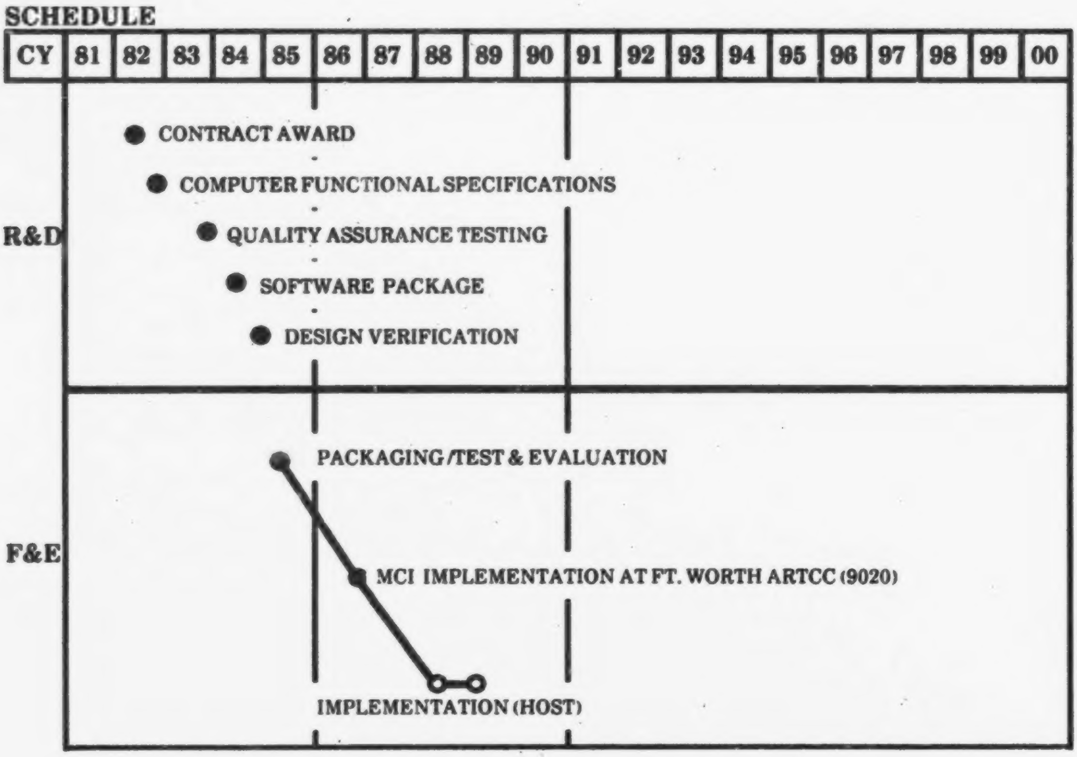
PROJECT 10: Conflict Alert IFR/VFR Mode C Intruder

Purpose: This project will provide computer assistance to en route radar controllers to identify potential conflict situations between IFR aircraft and VFR Mode C-equipped aircraft. The conflict alert IFR/VFR Mode C intruder function is an enhancement to the conflict alert function currently in use in the en route system. This software enhancement extends the conflict alert functions to include cases where IFR aircraft are approaching potential conflict situations with VFR aircraft that are equipped with altitude reporting (Mode C) transponders.

Approach: Software to perform this function has been developed and delivered for incorporation into the NAS en route automation system, first in the 9020 and then in a revision of the host software. The Mode C intruder function was installed into the Fort Worth ARTCC 9020 in June 1986.

Products: One computer program adapted for use at 20 host-equipped air route traffic control centers.

Related Projects/Activities: The Conflict Resolution Advisory function will use the output of the Mode C Intruder function. The host computer software will be revised to implement Conflict Alert IFR/VFR Mode C Intruder.



PROJECT 11: Voice Switching and Control System (VSCS)

Purpose: This project will provide a voice communications system which performs the intercom, interphone, and air-ground voice connectivity and control functions needed for air traffic control operations in an ARTCC/ACF The VSCS must satisfy the voice communications reconfiguration and service availability needs of the ACFs, reduce leased service costs, increase modularity and growth capability, and increase controller productivity.

Approach: The VSCS will use existing off-the-shelf technology adapted to meet FAA requirements. Two competing prototype systems will be produced and evaluated prior to award of a contract for the final 26 systems. The production contractor selection may be made earlier if sufficient confidence in the design is established. The VSCS contractor will design position equipment compatible with the man-machine interface used for the sector suite. The position equipment will be designed in accordance with a development specification provided by the advanced automation system (AAS) contractors. The AAS contractor will position the voice communications equipment and display devices to best fit the total man-machine interface and console design. An interface is required with the AAS for reconfiguration and status reporting purposes. A set of predetermined reconfiguration maps will be embedded in the VSCS. Capability to modify or create new reconfiguration maps from designated VSCS positions shall be provided.

In FY-84, VSCS operational requirements were finalized. Also, a draft production specification for coordination with industry and in-house FAA elements was issued. The VSCS prototype systems contract was awarded in early FY-87.

Following prototype demonstrations at the FAA Technical Center, a production contract award is planned in 1990. The FAATC prototype equipment will be upgraded to production specifications, integrated and tested prior to commencing field deliveries. VSCS will be implemented in the existing ARTCC consoles prior to implementation of the ISSS.

Products:

- One system per ACF, and position equipment for each operational control position.
- Two systems for the FAA Technical Center and one for the FAA Academy.

Related Projects/Activities:

- VSCS must be available and installed prior to the initial sector suite implementation.
- Radio Control Equipment – Performs the radio channel signaling and control functions to support ground/air voice communications.
- Multichannel Voice Recorders - To record all voice communications between air traffic controllers and pilots.
- AAS – Interfaces with the VSCS for configuration status and control data.

This project will require interfacility communications service from NICS. The project providing the required transmission network service is the RML Replacement and Expansion.

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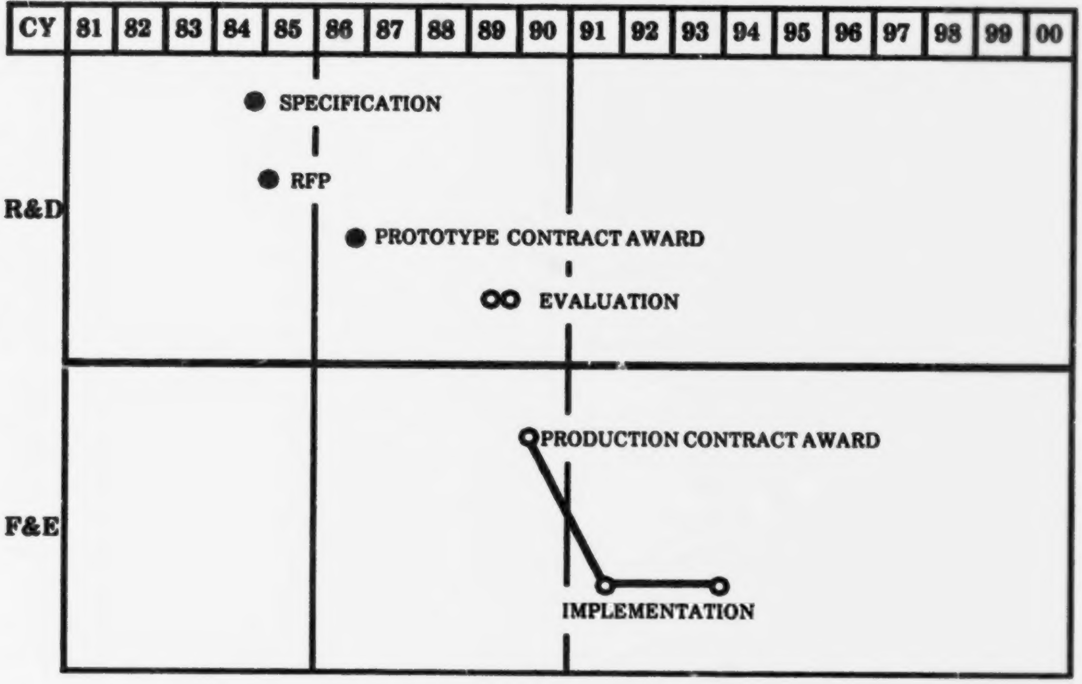
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EVALUATION
F&E
PRODUCTION CONTRACT AWARD
IMPLEMENTATION

PROJECT 12: Advanced Automation System (AAS)

Purpose: The advanced automation system will provide a new automation system that includes improved controller work stations, computer software, and processors. The advanced automation system will provide: the capacity to handle the projected traffic load through the 1990s and beyond; the capability to perform the new functions to be introduced into the ATC system through the 1990s; increased productivity through introduction of new sector suites; a high degree of reliability and availability; and the capability for enhancement to perform other functions subsequently introduced into the system.

Approach: The advanced automation system will be designed through a top down, evolutionary, total system approach. This design will be in parallel with host computer development and deployment. Transition to the AAS will consist of four steps: 1) implementation of the initial sector suite system (ISSS); to provide new controller work stations; 2) implementation of AAS hardware and the software that provides terminal advanced automation (TAA) functions; 3) implementation of the remaining AAS software for en route functions; 4) implementation of tower control computer complexes (TCCC).

Controller sector suites will consist of common consoles used for both en route and terminal functions. They will incorporate an improved man-machine interface, including the use of color displays and electronic presentation of flight data to enhance controller productivity. The sector suites will be initially installed in en route facilities served by the host computers.

The sector suites will initially be installed in a sterile environment previously provided by the expansion of ARTCC buildings to accommodate the host computer and by reclaiming a part of the existing control room. After transition to the initial sector suite system, the old control room will be refurbished to accommodate additional sector suites necessary for terminal consolidation resulting from implementation of the Area Control Facility (ACF) project.

Implementation of the TAA for TRACON functions will be the second step. AAS processors, and additional sector suites will be introduced. Software functions required to process terminal radar inputs and provide approach and departure control of terminal traffic will be implemented.

The third step in the evolution to full AAS is the addition of hardware and software to perform en route functions. Additional sector suites will be installed to enable conversion of ARTCCs into ACFs. The hardware/software associated with this step will be referred to as the area control computer complex (ACCC).

The final step will be the installation of TCCCs in selected air traffic control towers. TCCCs will be installed over an extended period, beginning when approach/departure control is provided by TAAs, and ending some five years later.

The advanced automation system will make possible the full integration of en route and terminal operations in the area control facilities.

In FY-84, two design competition contracts were awarded. Preliminary design review was completed in early FY-87. Acquisition phase contract award is planned for FY-88. An incremental production commitment for each of the above steps will be made only upon completion of FAA acceptance and operational suitability tests at the FAA Technical Center.

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Products: The scope of the AAS project includes construction and site preparation that is specifically required for the implementation of the AAS at area control facilities.

- Advanced automation system design.
- Advanced automation system software for both terminal and en route ATC operations.
- Advanced automation system computer hardware.
- ISSS (20 CONUS ARTCC).
- TAA (up to 20 locations).
- ACCC (23 ACFs - including Anchorage, Honolulu, and the New York TRACON).
- TCCC (up to 300 towers).
- Support Systems at FAATC and Aeronautical Center.

Related Projects/Activities: The modern ATC host computer project is the first transitional step of the advanced automation program. Past development projects will provide input to the sector suite and TCCC position console designs. The AAS is the automation system for the ACFs. The VSCS and Tower Communications System projects will provide the voice switching and communications necessary for AAS implementation.

The AAS en route software will include AERA 1 functions and facilitate later implementation of AERA 2/3 functions. The enhanced DARC is required for the transition to AAS and will be removed following AAS implementation. CWP, Mode S, Traffic Management System, and RMMS all interface with AAS. The AAS equipment will interface with subsystem(s) of the remote maintenance monitoring system (RMMS). This project will require inter facility communications service from NICS. Projects providing the required switching and transmission network service include NADIN, RML Replacement and Expansion, and Data Multiplexing.

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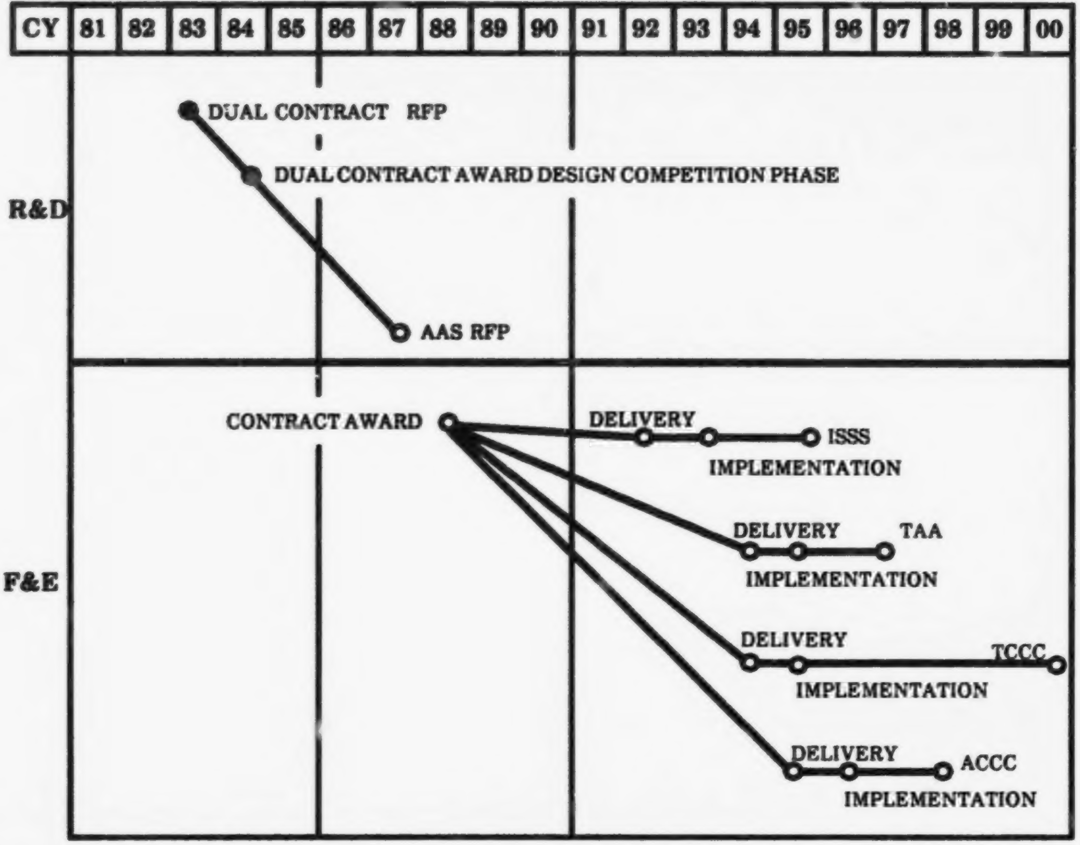

PROJECT 13: Automated En Route Air Traffic Control (AERA)

Purpose: This project will provide interactive software for use by the area control facility to plan and monitor the 4-dimensional flow of air traffic. Specifically, AERA will: (1) permit most aircraft on IFR flight plans to fly fuel-efficient profiles, (2) increase safety of the system by reducing the potential for operational errors, (3) increase system capacity by integrating en route metering with local and national flow control, and (4) increase controller productivity by increasing the number of aircraft and volume of airspace that a control team can safely manage.

Approach: AERA will be developed in three implementation packages -- AERA 1, AERA 2, and AERA 3. AERA 1, designed primarily to provide user benefits, will be delivered with the area control computer complex (ACCC) software and will be used operationally approximately six months after ACCC implementation. AERA 1 is based on developing a 4-D flight path trajectory estimation model to support such features as:

- Flight plan conflict probe which will predict potential violations of separation standards between aircraft and between aircraft and special use (e.g., restricted) airspace.
- Sector workload analysis which will calculate and display personnel workload measures to supervisors and specialists to assist them in balancing sector staffing levels.
- Trial flight plan function which will allow controllers to evaluate alternative clearances prior to issuing them to aircraft.
- Reconformance aid which will assist controllers in reestablishing aircraft conformance with their flight plan positions.
- Reminder function which will assist controllers by reminding them of planned actions.

AERA 2 will be the first enhancement to the ACCC and is aimed primarily at increasing controller productivity. It will extend the AERA 1 functions from detecting potential conflicts to providing the controller with resolutions. It will also extend the planned action advisory function to include all planned actions, such as planned conflict resolutions, metering actions, etc., and introduce the concept of computer-generated data link clearances.

AERA 3 represents the final AERA development step and is intended to extend the AERA capability from automatic clearance generation to automatic clearance delivery via data link.

Each AERA development package will undergo a series of rigorous engineering and validation steps consisting of algorithmic development, operational suitability evaluations, computer performance functional specification development, and field implementation.

Products: Functional specifications for the AERA 1 functions were completed in FY-84. AERA 1 research and development was completed in early FY-85 and operational development will be accomplished as part of the advanced automation system. AERA 2 functional specifications were completed in FY-86. The next step in AERA 2 will be to develop performance and detailed algorithmic specifications. Then software will be prepared for ATC laboratory simulations to evaluate operational suitability. Production of AERA 2 operational software will begin after operational suitability has been demonstrated. AERA 3 concept development will continue through 1987 and functional specifications are scheduled for completion in FY-95. Implementation will begin after complete implementation of ACFs.

Related Projects/Activities:

- Advanced Automation System (AAS) - The AAS will include AERA 1 functions and facilitate later implementation of AERA 2 and AERA 3 functions.
- Traffic Management System - AERA will provide key en route traffic conditions and prediction data to the traffic management system. The upgraded traffic management system will be integrated with AERA to keep both short and long-term traffic planning coordinated.
- Data Link - Interfaced through AAS, will provide automated controller/ pilot data and advisory interchange.
- Weather projects - Products provided by the center weather service unit will be utilized by AERA. More accurate wind data than is currently available, provided by the weather projects, will improve AERA performance.

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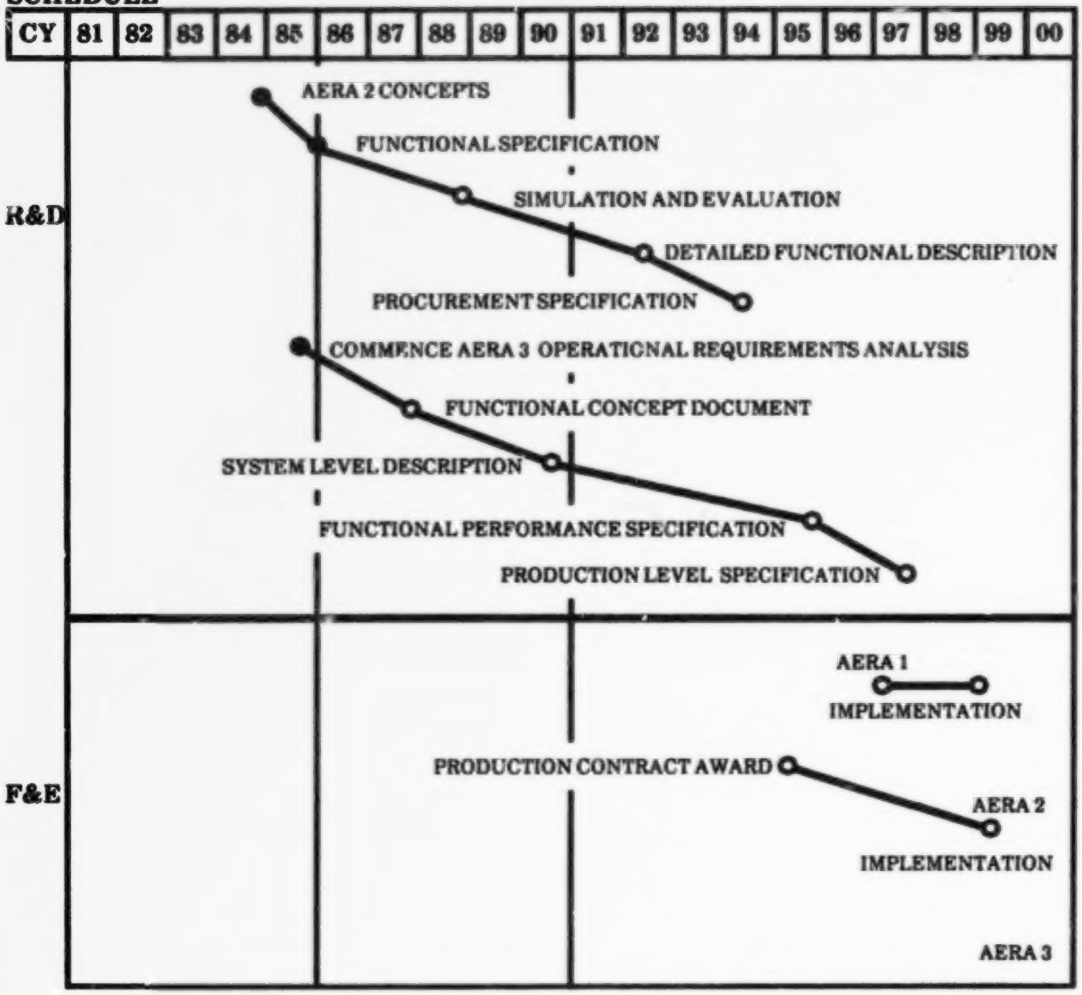
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IMPLEMENTATION
AERA 3

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PROJECT 14: Integration of Nonradar Approach Control into Radar Facilities

Purpose: This project will expedite movement of air traffic by integrating the volume of air traffic now handled by nonradar approach control facilities into facilities with radar. Integration will reduce the total number of operational control positions and improve service to users by eliminating delays induced by use of nonradar procedures and interfacility coordination.

Approach: The responsibility for providing air traffic control service in the airspace at identified airports will be reassigned from a nonradar facility to a proximate facility having radar capabilities and appropriate radar coverage. The significantly smaller separation minima that are available through the use of radar can be applied throughout the airspace both for arrivals and departures, as well as radar vectors to the final approach course, navaids, fixes, or initial altitude where feasible. This will result in increased controller productivity, fewer delays, greater air traffic capacity, and increased safety through radar traffic advisory service.

Products: Fifteen nonradar control facilities have been integrated into existing radar facilities. Productivity has increased in all such facilities. An additional four nonradar facilities will be integrated between 1987 and 1989.

Related Projects/Activities: None.

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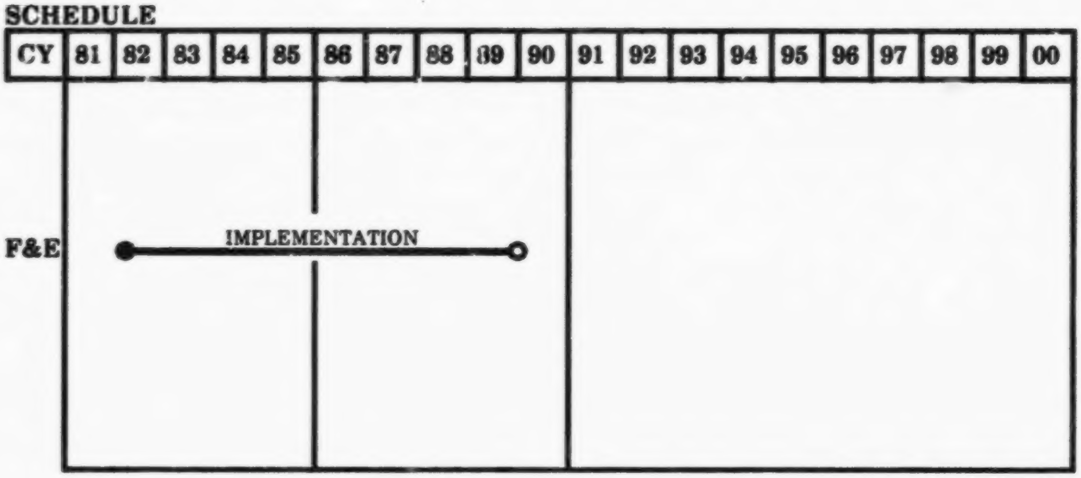

PROJECT 15: Area Control Facilities (ACF)

Purpose: This project will improve air traffic control service to users, increase Air Traffic and Airway Facilities personnel productivity, and absorb growth through consolidation of air traffic control facilities. Additionally, creation of ACFs minimizes the cost of providing identical advanced automated features to en route and terminal controllers at a large number of facilities.

ACFs will have realigned boundaries based primarily on traffic flows throughout large geographic areas, accommodating arrival, departure, and en route control in one type of facility. These realigned boundaries will be designed by technical activities committees which are comprised of controllers from affected terminals and centers. All necessary control towers will remain in existence, but radar control facilities will be reduced from 212 (22 ARTCCs, 2 CERAPs and 188 TRACONs) to 23. The 23 ACF locations envisioned under today's concept include the 20 contiguous ARTCCs, Honolulu ARTCC, Anchorage ARTCC, and the New York TRACON.

Approach: There are many programs/projects progressing concurrently in the en route, terminal, and flight services areas which will culminate in the establishment of area control facilities. The thrust of the ACF project is directed towards maximizing the capabilities of technological advances created by these programs/projects to provide even higher levels of safety, service, and efficiency in the operation and use of the ATC system. The ACF project will be accomplished in two phases:

Phase I - "Pre-ACF Activities" consist of those activities that are necessary prior to the establishment of ACFs. These activities will ensure that other related programs underway during this phase are compatible with ACF development. Such programs (e.g., ARTCC building expansion/modernization, installation of the host computer, upgraded software, initial sector suite system, new communications networks, installation of the AAS equipment with terminal advanced automation (TAA) and the area control computer complex (ACCC), and additional training) will be completed during this phase. Certain areas of the ACF buildings must be refurbished and remodeled to provide adequate space to support facility operations well beyond the year 2000. Space will be provided throughout the period of transition in support of on-site training, contractor support, storage and other space requirements. Major activities will include:

- ACF airspace redesigns.
- Upgrading environmental systems.
- Expanding and upgrading administrative and support areas.
- Upgrading vacated electronic equipment rooms.
- Increasing facility security.
- Modification/reconfiguration/relocation of certain existing systems to satisfy ACF requirements.

All programs will be monitored and coordinated by the ACF program office to ensure that Phase I activities will proceed with a minimal amount of disruption to normal operations. Phase I begins in 1989 and is scheduled to be completed in 1995.

Phase II – "ACF Establishment Activities" provide for the actual establishment of ACFs throughout the country. These activities will consist of relocation/consolidation of approximately 188 TRACONs and the necessary remoting of radar interfaces and communications. Also during this time frame, the refurbishment of the space vacated by the relocated TRACONs and the modernization of the remaining tower cabs to receive tower control computer complexes will be completed. Provisions will also be made to provide for changing requirements, etc., for the duration of this phase.

Products:

- Twenty-three area control facilities will provide arrival, departure, and en route control functions resulting in more efficient/effective air traffic management by improved procedures and operations, fewer communications transfers, and optimized severe weather avoidance procedures.

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- Fuel savings will accrue to users because of fewer altitude restrictions, better profile descent/en route metering, and increased direct routing.

- Higher productivity will be realized because of optimized use of advanced automation, and a functionally integrated controller work force.

- Significant cost savings will result due to fewer buildings and grounds to maintain, and fewer automation systems to maintain.

Related Projects/Activities: ARTCC Building Expansion/Modernization, Advanced Automation System (AAS), radar remoting and digitizing, VSCS, navaids networking, military liaison, weather programs, e.g. CWP and maintenance control centers. This project will require interfacility communications service from NICS. Projects providing the required switching and transmission network service include NADIN, RML Replacement and Expansion, and Data Multiplexing.

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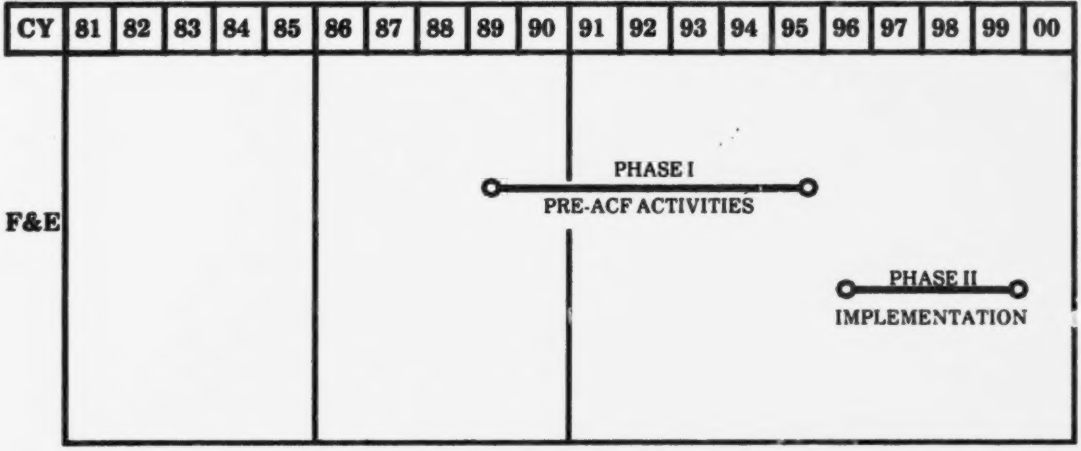


PROJECT 16: Offshore Flight Data Processing System (OFDPS)

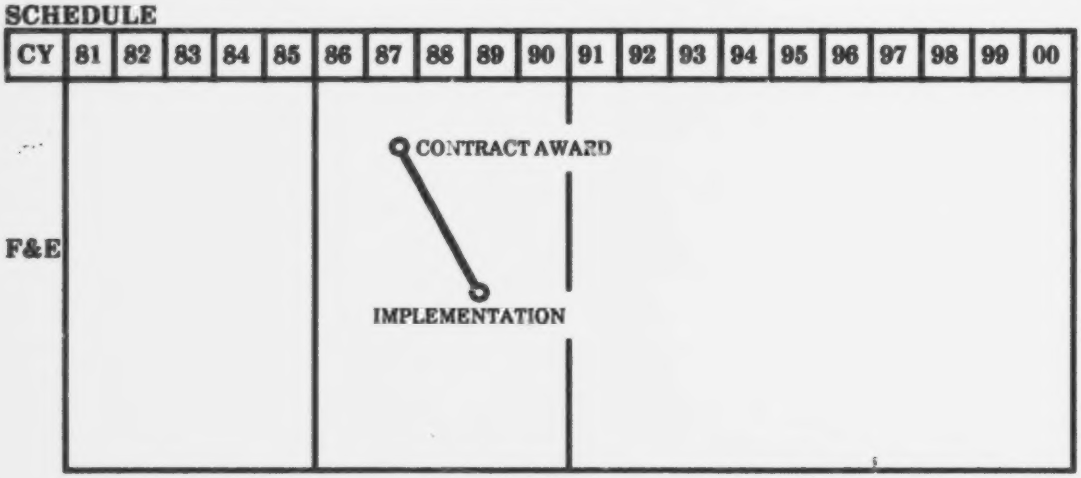
Purpose: This project will replace the compact flight data processing system (CFDPS) currently in use at the Honolulu ARTCC. The CFDPS consists of obsolete data processing equipment. The system is labor-intensive, provides limited functions with limited interfaces in non-real time, uses outmoded equipment that is operating at capacity, is reaching the point where software and hardware support are diminishing, and, thus, is only marginally reliable. The replacement system will consist of modern equipment and associated software which will provide real time enhanced functional capabilities, including comprehensive flight data processing, needed interfaces, system reliability, increased system capacity, and flexibility, while ensuring that safety is maintained.

Approach: An automated flight data processing system is being developed which will combine the flight data input/output (FDIO) system with a duplex flight data processing system (FDPS). The FDIO system will be used for data entry and display, while the FDPS will be used to process flight data. The OFDPS duplex system will consist of redundant computers for flight data processing with a communications subsystem composed of redundant processors to provide the necessary interfaces with other systems. The adaptation software will permit modifications to satisfy Honolulu ARTCC site-specific requirements.

Products: One upgraded offshore flight data processing system.

Related Projects/Activities:

- FDIO equipment is scheduled for delivery to the Honolulu ARTCC and associated terminals. Operational use of OFDPS depends on the implementation of the OFDPS/FDIO software interface.
- This project will require interfacility communications service from NICS. Projects providing the required switching and transmission network service include NADIN and Data Multiplexing.



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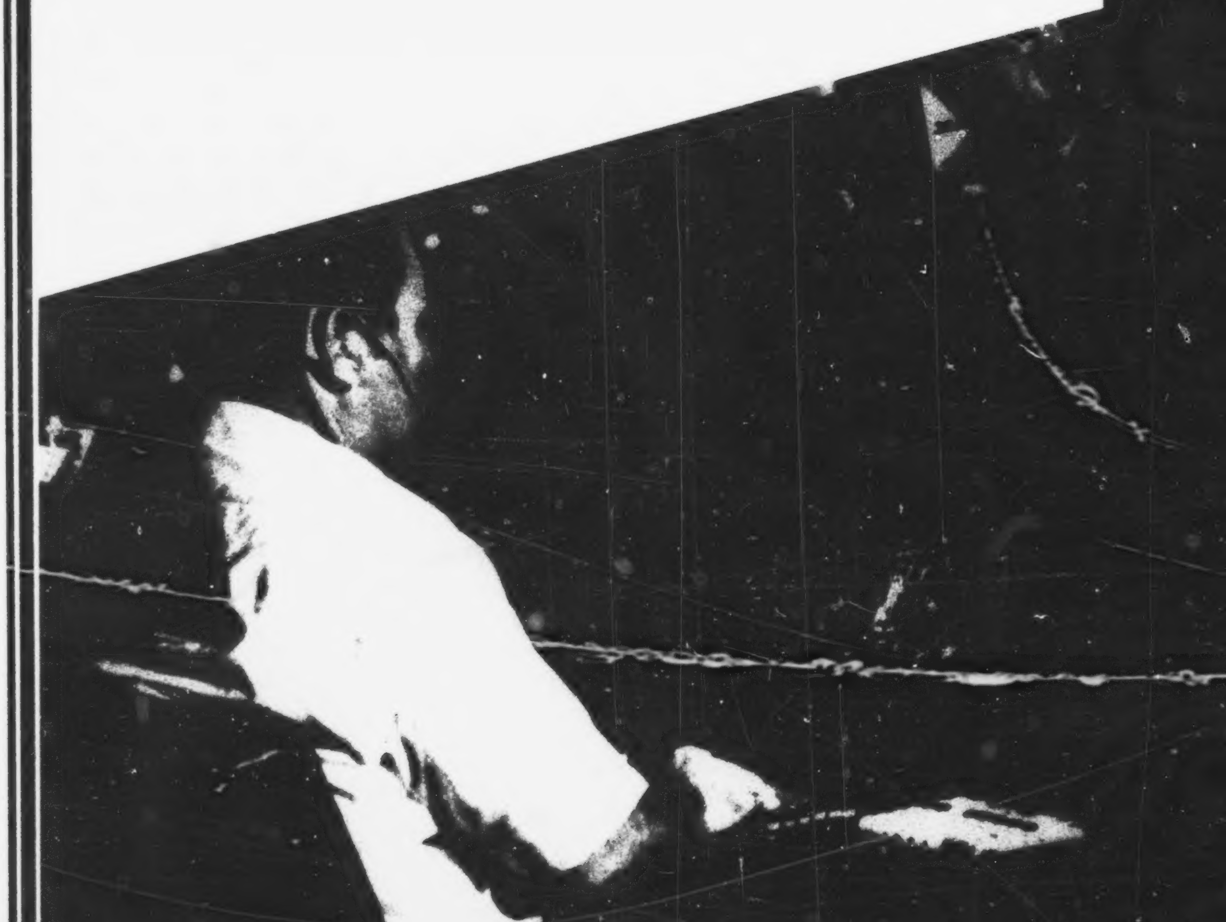

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TERMINAL SYSTEMS

The three major types of facilities used in terminal air traffic control are the airport traffic control tower (ATCT), terminal radar approach control (TRACON), and terminal radar approach control in the tower cab (TRACAB). Located on airports, the ATCTs are the most common, as well as the most visible. Their purpose is to separate aircraft, sequence aircraft in the traffic pattern, expedite arrivals and departures, separate aircraft on the landing areas, and provide clearance and weather information to pilots.

The second most common are the TRACONs that control airspace around airports with moderate-to-high density traffic. TRACON controllers separate and sequence both arriving and departing flights. Normally, each TRACON is associated with one ATCT and located within the same building. However, a TRACON may be remotely located and may serve more than one ATCT. The third type, the TRACAB, serves a function similar to that of the TRACON. TRACABs are located within tower cabs at airports with lower density traffic.

All terminal air traffic control facilities are equipped with radio communications to aircraft; have telephone communications to air route traffic control centers and flight service stations; and have a variety of equipment for observing, detecting, receiving, and displaying weather information. Radios and telephones are major tools of the terminal controller.

Terminal ground-to-air communications are conducted with VHF or UHF transmitters and receivers. Current ATC ground-to-air communications require many frequency changes as aircraft move through the system.

Terminal ground-to-ground communications use a variety of old switching systems. These systems are leased and range in complexity from simple systems used in many small ATCTs to Western Electric 301 and 301A systems used at TRACONs. (Initial efforts for improving the terminal and other communication systems are covered in the Flight Service and Ground-to-Air chapters.)

At qualifying terminal ATC facilities, computers are used to relieve the controller of routine tasks and give the controller information that assists in maintaining aircraft identification. In addition, information such as altitude and aircraft speed, which must be provided by the pilot in a nonautomated environment, is displayed on the controller's screen by means of alphanumeric symbology.

The TPX 42 equipment is the least sophisticated of the terminal automation systems. It is a non-programmable, numeric beacon decoder system. That is, information from an aircraft's transponder is decoded and displayed for the controller in numeric form along with normal radar data. It provides aircraft transponder code and altitude information for suitably equipped aircraft. TPX 42 is used at lower activity terminal radar facilities.

The automated radar terminal system (ARTS II) is a programmable, nontracking data processing system. Although it does not provide tracking, the ARTS II does provide meaningful information such as aircraft identification and altitude to the controller. Like TPX 42, ARTS II derives its information only from the aircraft's transponder. ARTS II can be interfaced with the ARTCC computer for the automatic exchange of information. ARTS II is used for facilities having low-to-medium activity. At present, ARTS II has no unique software other than minor adaptations to the basic operational program.

The automated radar terminal system (ARTS III) is a programmable beacon tracking system. Based on information from the aircraft's transponder, the ARTS III detects, tracks, and predicts the position of aircraft in the terminal area. The information is displayed on the controller's radar scope by means of computer-generated symbols and alphanumeric characters, along with normal radar data. The computer displays aircraft identification, altitude, ground speed, and flight plan data. In addition, the ARTS III is interfaced with the ARTCC computer allowing the computers to exchange information.

At present, ARTS III is installed at medium-to-high activity terminal facilities. Currently, there are two unique features provided by ARTS III through software. The first is the minimum safe altitude warning (MSAW). MSAW is a function of the ARTS III computer that will alert the controller when a tracked aircraft, with altitude reporting capability, is below or is predicted by the computer to go below a predetermined minimum safe altitude. The second is conflict alert. Terminal conflict alert (CA) is a computer function that alerts the controller to the situation that aircraft are in close proximity and possibly require attention or action.

The ARTS IIIA is an enhancement of the existing ARTS III designed to meet increasing traffic demands in terminal airspace. The ARTS IIIA is capable of tracking search radar targets as well as transponder-equipped aircraft. Thus, all aircraft that are within radar coverage of ARTS IIIA are candidates for computer processing. Like ARTS III, ARTS IIIA interfaces with the ARTCC computer and contains the unique software features of MSAW and conflict alert.

Flight data entry and printout (FDEP) provides an automated means of printing terminal flight progress strips. FDEP equipment interfaces with the ARTCC computer and is used extensively throughout the system to exchange flight data automatically between ARTCCs and terminal approach control facilities and associated control towers.

Bright radar indicator tower equipment (BRITE) is a supplemental radar display and alphanumeric system designed for use in the bright light environment of the ATCT cab.

The current terminal ATC system consists of over 400 ATCTs and nearly 200 TRACON/TRACABs.

THE NEW APPROACH

The objectives of the terminal system improvement plan are to maintain a very high level of safety; impose minimum constraints consistent with efficient use of the system; and, at the same time, minimize FAA operations costs. This involves extended use of automation and reduction of required air traffic control facilities.

For the initial effort, the new approach means making hardware and software improvements to existing ARTS automation systems and improvements to the supporting facilities and voice communication switching systems.

Over the near term, the new approach involves replacement of the automation equipment to provide capacity for traffic growth, higher system reliability, and the addition of safety and efficiency enhancements.

In the long term, automation will be extended to create an integrated flow management system which will maximize airport capacity, smooth traffic flow, and reduce aviation fuel consumption. Consolidation of terminal air traffic control facilities will be undertaken to increase controller and technician productivity. The TRACONs and TRACABs which currently exist will be consolidated into 23 area control facilities (ACFs). This will blend the separate functions of terminal and en route air traffic control into ACFs. Supporting ATCTs will remain. Facility consolidation is expected to reduce the flight coordination between pilots and controllers and result in significant savings in equipment, personnel, and operating costs. Upgrading automation and voice communication switching will be the cornerstones of facility consolidation.

The advanced automation system (AAS) in the ACF will support both en route and radar approach control functions. The sector suites used for radar approach control will be identical to those used in en route air traffic control.

Tower control computer complexes (TCCCs) will be developed for ATCT use. Area control facility (ACF) sector suite components will be used to the maximum extent possible, but will have unique display characteristics for use in the space-limited, high-intensity light environment of the ATCT cab. TCCCs will satisfy the tower requirements for radar position display, intent and identity information, flight data, weather data, and flow planning information.

The consolidation of these TRACONs and TRACABs into the ACFs will improve air traffic productivity and provide significant cost-savings by eliminating multiple life-cycle costs for operation, training, supply support, engineering, and software associated with ARTS systems.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Initial effort improvements have focused on higher productivity among air traffic controllers and airway facilities maintenance technicians, and control of communications costs. Software and hardware have been developed to provide conflict alert and minimum safe altitude warning for

ARTS II. Software to enhance conflict alert at ARTS III locations has been developed to reduce nuisance alarms.

Additional ARTS II displays have been provided for eight locations. ARTS III memory has been expanded at initial locations to provide capacity for traffic growth. The capability to hand off aircraft and transfer flight data automatically between ARTS II and ARTCC facilities has been added to reduce controller workload at most facilities. An automated ATC capability in the R-2508 restricted area of California has been created to prevent midair collision of civil and military aircraft. The first integrated communications switching system (ICSS) has been provided to decrease leased communications costs. Additional power conditioning systems have been installed at ARTS III locations to improve reliability. A second ARTS system and a modernized software assembly system has been installed this year at the FAA Technical Center to sustain the system support functions. Research and development have begun on the advanced automation system, including the unique features required of the tower suites.

ATCT modernization and relocations continue as necessary. Design of ARTCC modifications and expansions to accept ACFs has begun.

NEAR TERM (TO 1990)

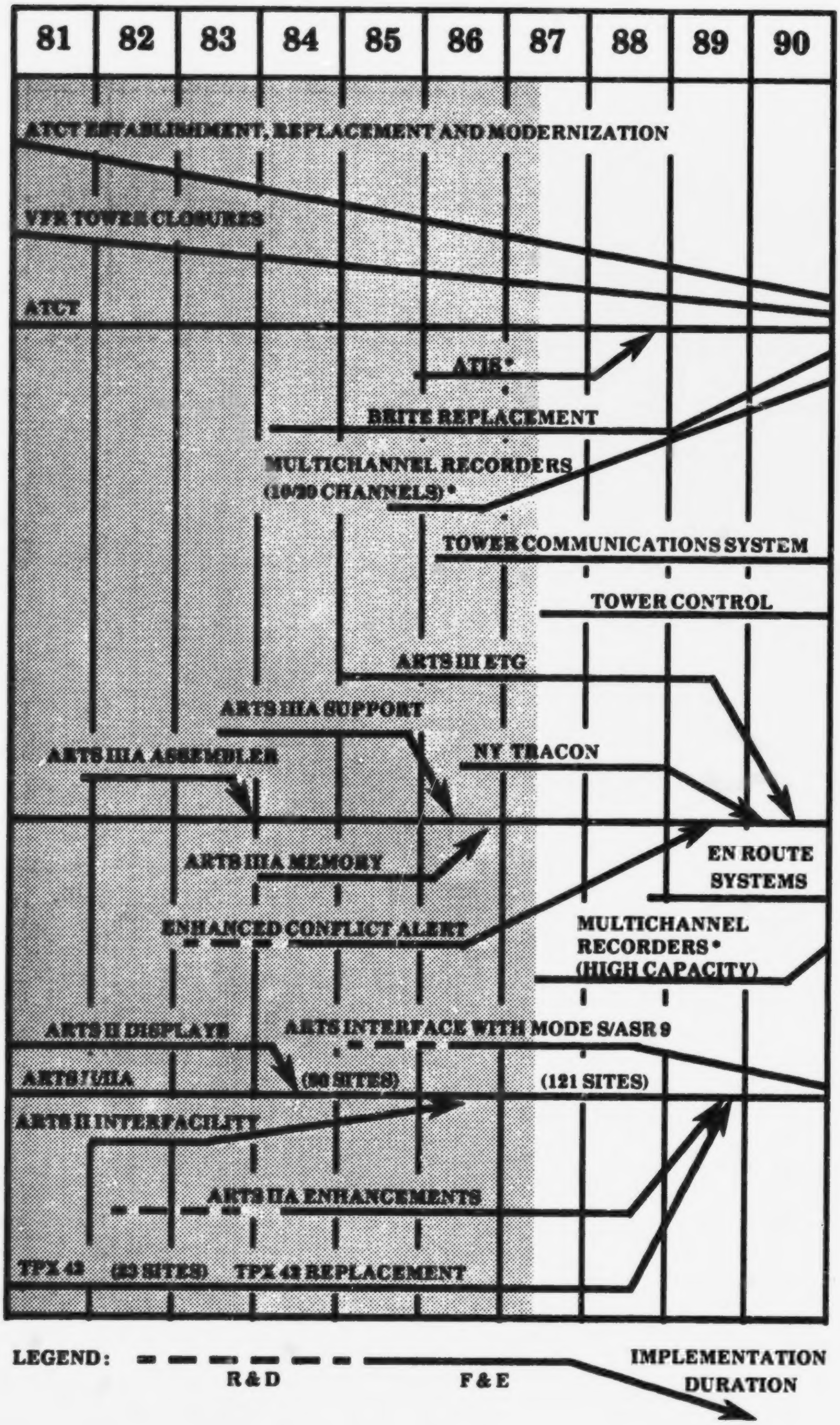
During the near term, ARTS IIAs will upgrade ARTS IIs and replace TPX 42s to provide tracking capability and software for conflict alert and MSAW. Conflict Alert for ARTS IIIA and the New York TRACON will be enhanced. The remaining ARTS IIs (with the exception of Hawaii and Alaska) will be interfaced with ARTCC computers. Enhancement of the controller training capabilities at ARTS III locations will be provided to expedite controller training. Radar remoting to satellite ATCTs will be expanded to reduce collision risk. Replacement of BRITE systems will have begun to improve technician productivity. Automatic terminal information service (ATIS) recording equipment will be replaced with minimal maintenance models that will improve reliability and broadcast quality. Multichannel voice recorders will similarly begin to be replaced. The New York TRACON automation system will be improved to sustain operations with an increased capacity.

Construction for consolidated area control facilities will be underway. Research and development will be completed for sector suites, TCCCs, and voice switching and control systems. ATCT relocations and modernization will continue along with research into flow management. Modification of ARTS IIA facilities at airports served by ASR 9/Mode S surveillance systems to accept higher quality Mode S data and digitized radar input will be nearly complete.

LONG TERM (TO 2000)

Over the long term, the FAA plans to complete consolidation into area control facilities. The advanced automation system, TCCCs, and voice switching and control systems will allow operations personnel to handle increased traffic without a proportional increase in staffing. Tower communications switching systems will be upgraded at ATCTs. Improved weather products will be available at the sector suite. Computer software will be implemented for flow management products. Data link coverage will be extended down to 6,000 feet and will be utilized to provide weather and clearances to aircraft.

The following diagram and maps describe the evolution of the system.



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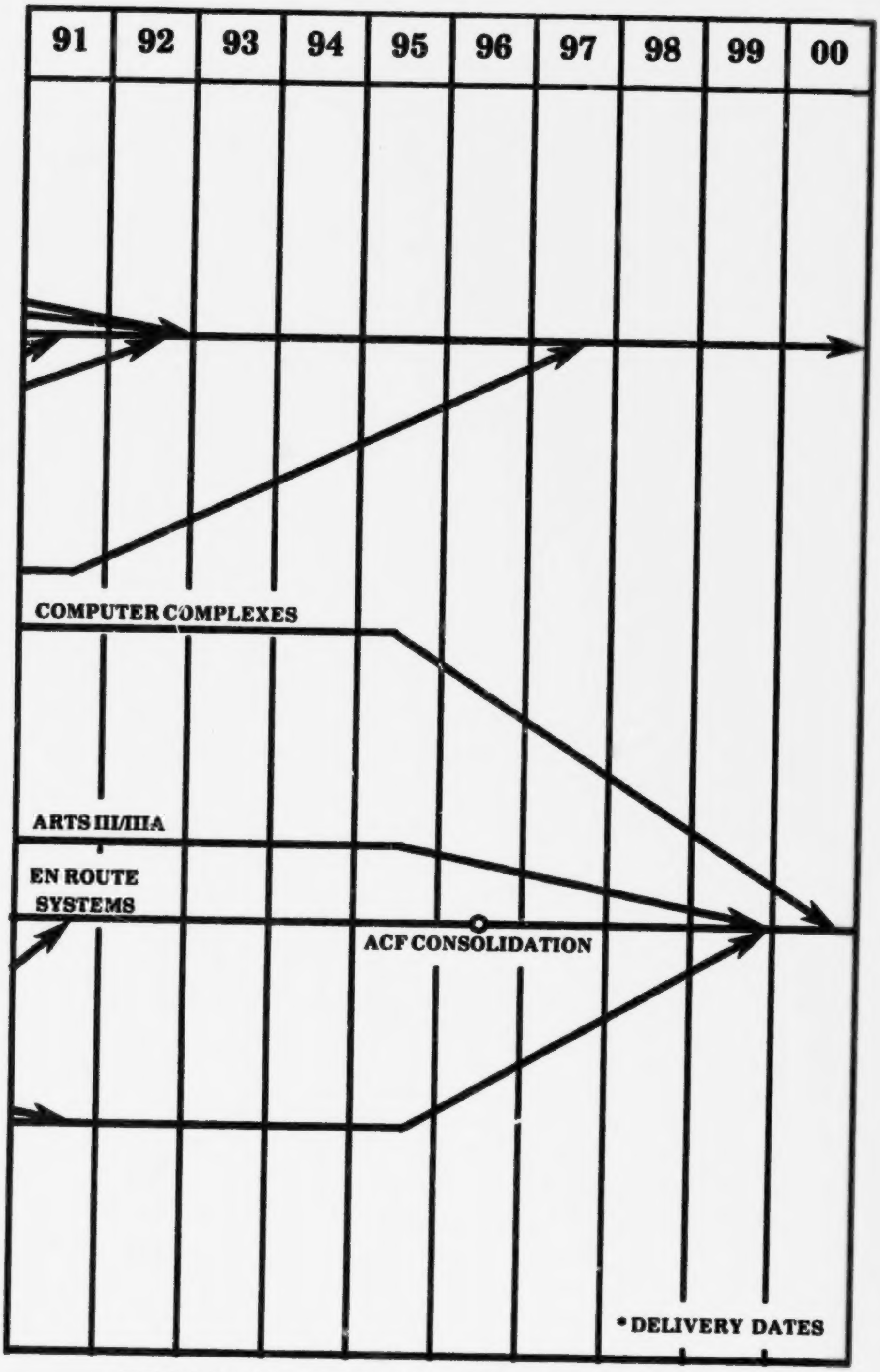
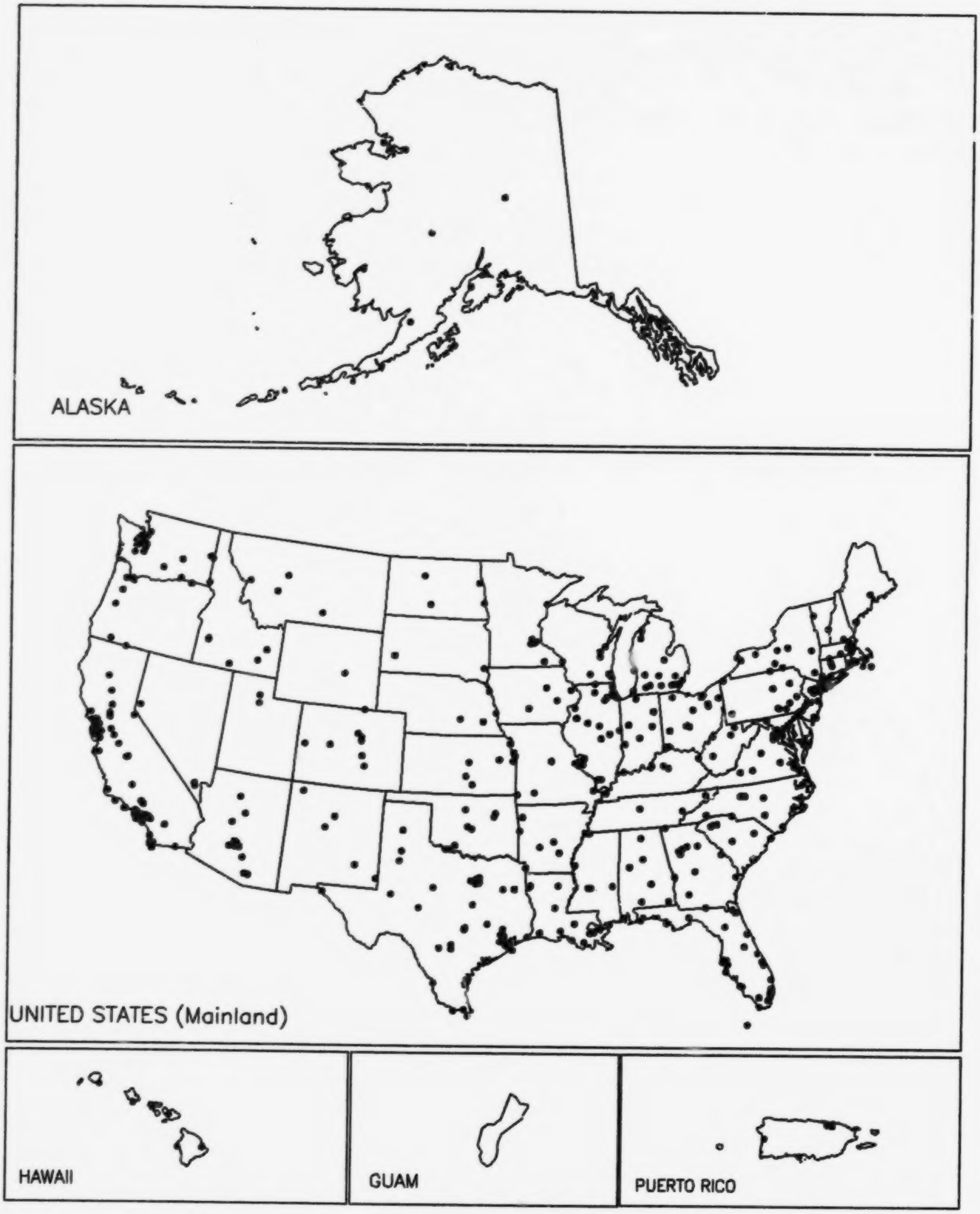


TERMINAL ATC SYSTEMS EVOLUTION

IN 1981 THERE WERE 432 FAA-OPERATED AIRPORT TRAFFIC CONTROL TOWERS IN THE SYSTEM. IN 1985, A TOTAL OF 454 AIRPORTS WERE SERVED BY FAA TOWERS. BETWEEN 1985 AND THE YEAR 2000, AS TRAFFIC ACTIVITY CHANGES AND REQUIREMENTS ARE EVALUATED, A NUMBER OF AIRPORT TRAFFIC CONTROL TOWERS WILL BE CLOSED AND ADDITIONAL TOWERS WILL BE ESTABLISHED AS NEEDED.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1985 SYSTEM
AIRPORT TRAFFIC CONTROL TOWERS

THIS MAP DEPICTS THE LOCATIONS OF AUTOMATION EQUIPMENT WHICH SUPPORT AIR TRAFFIC CONTROL OPERATIONS AT MAJOR AIRPORTS.

BY 1990, THE TPX 42 EQUIPMENT WILL BE REPLACED WITH ARTS IIAs AND PROVIDED WITH SOFTWARE ENHANCEMENTS SUCH AS MSAW AND CONFLICT ALERT. ARTS IIs IN THE CONTIGUOUS 48 STATES WILL ALL BE INTERFACED WITH THE ARTCC COMPUTERS AND THOSE SERVED BY MODE S/ASR 9 SYSTEMS MODIFIED TO PROCESS DIGITAL INPUT DATA.

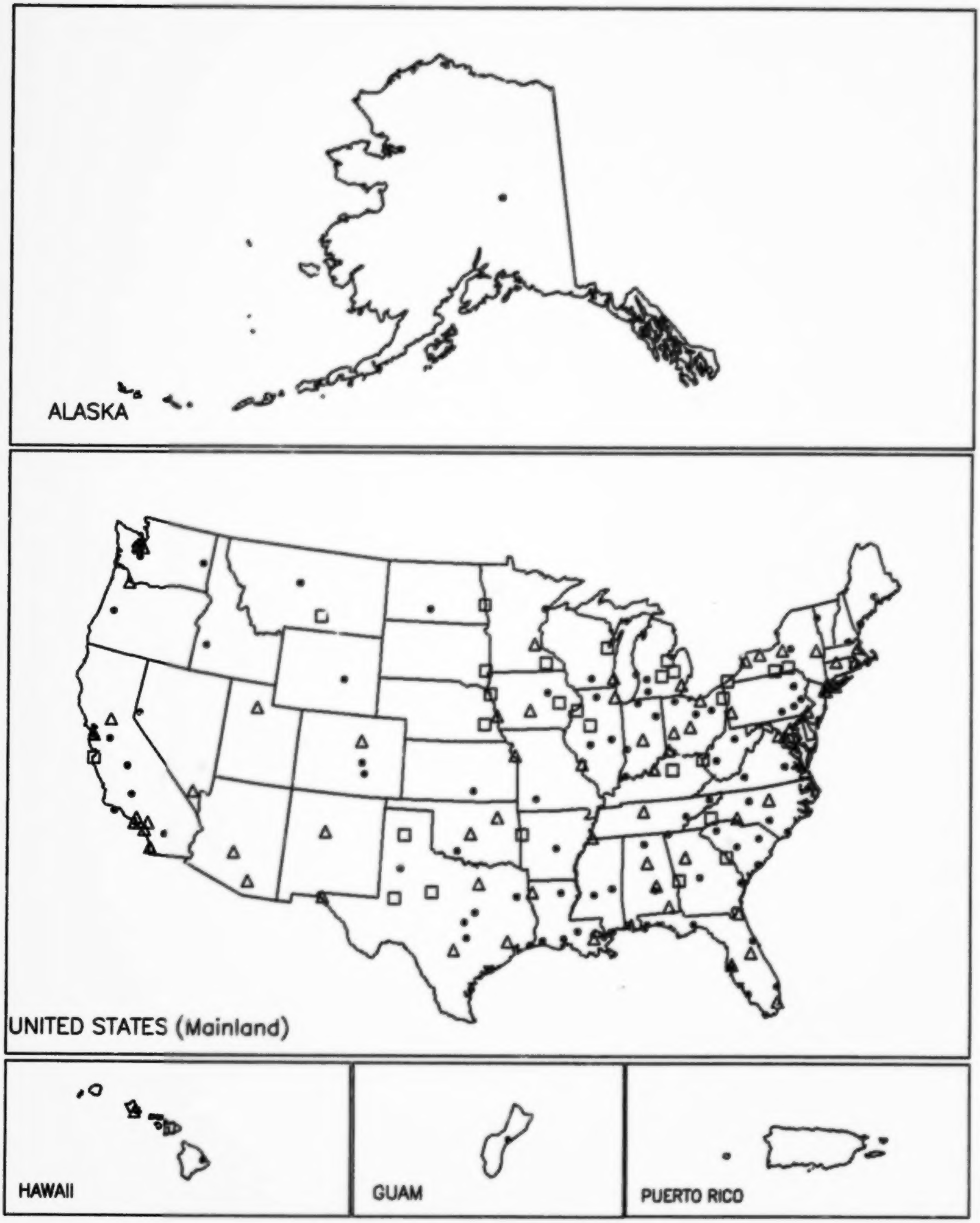
BY THE YEAR 2000, ALL ARTS SYSTEMS WILL BE DECOMMISSIONED AS THE RADAR APPROACH CONTROL FUNCTIONS ARE MERGED INTO THE AREA CONTROL FACILITIES. RADAR DISPLAYS IN THE TOWERS WILL BE REPLACED BY THE TOWER SUITE DISPLAYS, RECEIVING DATA FROM THE ACF COMMON RADAR DATA BASES.

1981 - 1990 SYSTEMS

● ARTS II LOCATIONS

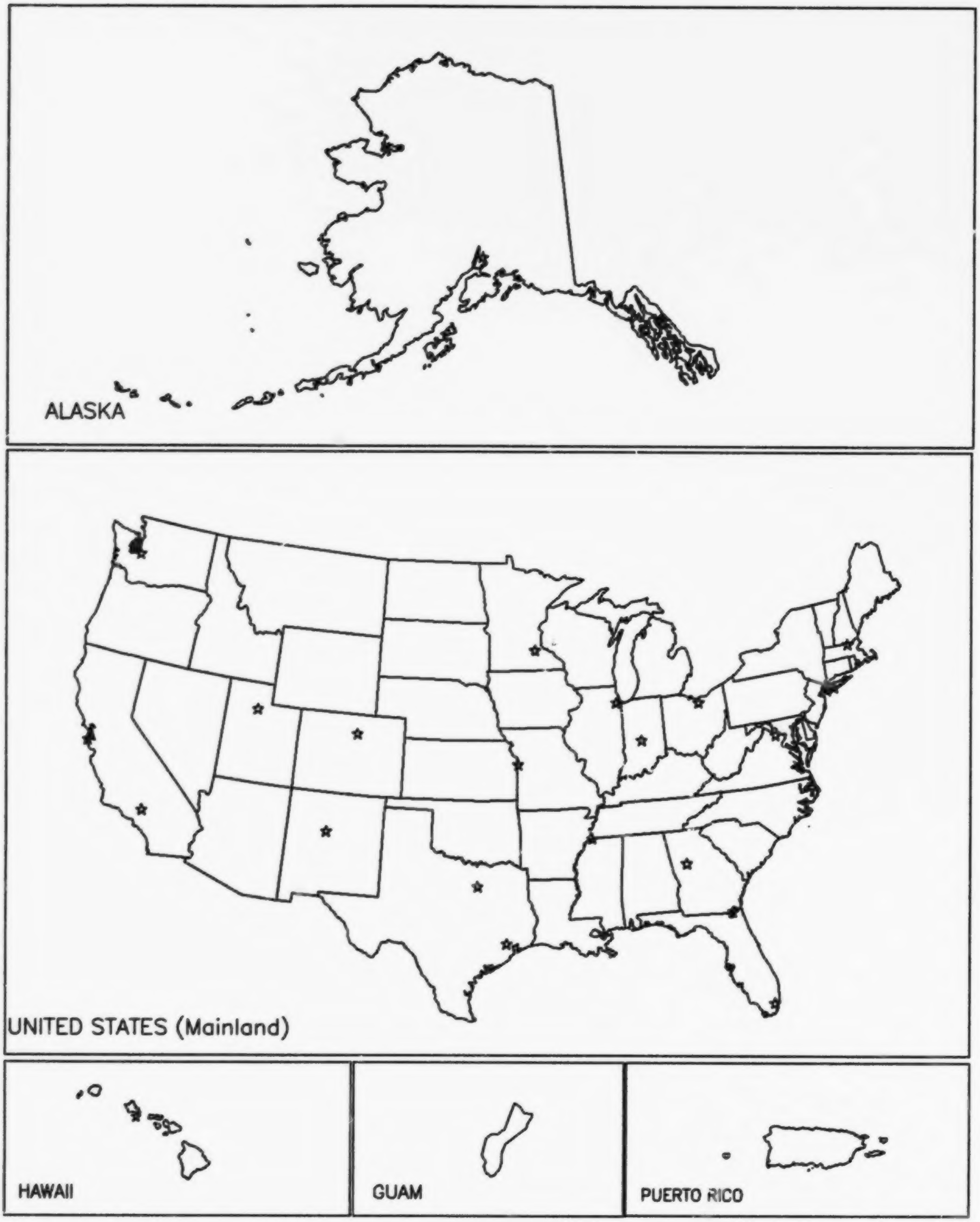
△ ARTS III LOCATIONS

□ TPX 42 LOCATIONS


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1981 - 1990 SYSTEM
AUTOMATED TERMINAL RADAR AIR TRAFFIC CONTROL FACILITIES

BY THE YEAR 2000, 21 CONUS AREA CONTROL FACILITIES AND 2 OFFSHORE ACFs WILL SUPPORT BOTH EN ROUTE AND TERMINAL FUNCTIONS. LOCATIONS MAY CHANGE AS PLANS CONTINUE TO DEVELOP.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

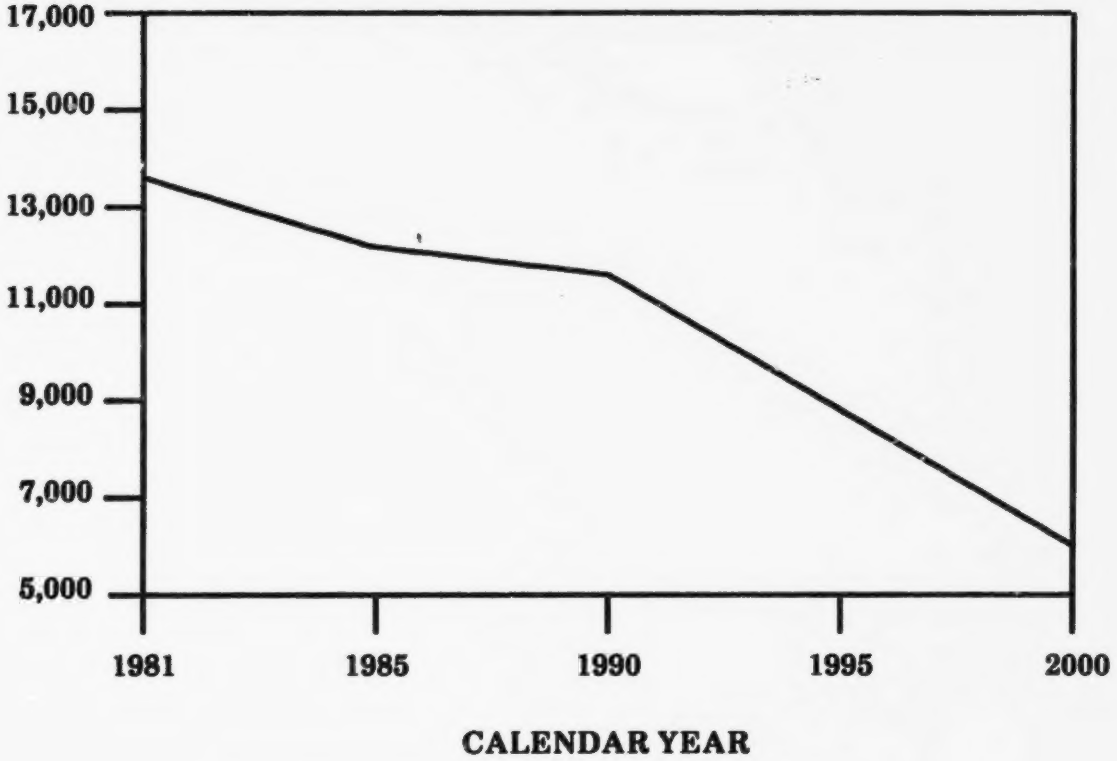
**2000 SYSTEM
AREA CONTROL FACILITIES**

RETURN ON THE INVESTMENT

During the next 13 years, terminal equipment will be significantly improved and comparable capabilities will be provided to the ACFs and ATCTs in a cost-effective manner. The reliability of the services which terminal systems provide will significantly improve. System capacity will be increased by the implementation of automated aids which reduce controller workload. Fuel efficiency will be maximized consistent with sustained flight safety.

FIELD EMPLOYMENT

These changes will result in changes within both Air Traffic and Airway Facilities field employment as shown in the chart below. The net effect will be a decrease in Airway Facilities personnel requirements at FAA field facilities by 37 percent and a decrease in the 1981 Air Traffic personnel requirements by 60 percent by the year 2000. However, this is partially offset by the increase in staffing described in the en route section. The total terminal and en route air traffic controllers staffing decreases by 22 percent.



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(TERMINAL SYSTEMS)

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SUMMARY OF FACILITY CHANGES

1981 - Airway Facilities and Air Traffic required 13,649 people to operate terminal facilities.

1985 - AF employment increased slightly. Solid-state conversion resulted in a decrease in electronic and environmental equipment maintenance workloads, but was offset by the establishment of additional BRITE, ATCT, and ARTS facilities. AT staffing requirements were reduced to 10,321 positions due to facility eliminations, transfer of seven non-radar approach control facility functions to ARTCCs, and terminal position review.

2000 - There will be considerable reductions in both AT and AF staffing due to the consolidation of TRACON operations into area control facilities and the resulting decommissioning of terminal automation and broadband radar display equipment. In 2000, total field staffing to operate and support terminal facilities will be down to 5,939.

Outyear estimates are reviewed annually and are subject to revision.

TERMINAL SYSTEMS
AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS

	1981	1985	1990	2000
Operations (Millions)	61.6	57.9	65.7	82.2*
Air Traffic Personnel	11,800	10,321	10,160	4,770
AT Productivity Quotient	5,220	5,610	6,467	17,232
Airway Facilities Personnel	1,849	1,885	1,568	1,169
AF Productivity Quotient	33,315	30,716	41,900	70,317
Total AT & AF Staffing	13,649	12,206	11,728	5,939
Air Traffic Personnel Costs (Thousands)	$351,640	$306,534	$301,752	$141,669
Airway Facilities Personnel Costs (Thousands)	$63,051	$64,279	$53,469	$39,863

*Tower services only. Approach and departure control services will be performed by area control facilities.

PROGRAM RELATIONSHIPS

The objective of the NAS Plan is the creation of a fully integrated air traffic control and navigation system capable of meeting the capacity, efficiency, and air safety demands anticipated by the turn of the century. Its projects are interrelated.

Implementation of the advanced automation system and area control facilities, described in the en route section of this plan, will bring about major changes in the methodology and hardware used in the terminal environment. In the mid-1990s, the radar approach control facilities will begin to be consolidated into area control facilities, supported by standardized equipment. New tower suites (the terminal component of the advanced automation system) will be installed in towers, integrating en route and terminal air traffic control by providing full access to traffic, flight, and weather data bases available in ACFs. Terminal facilities (including airport traffic control towers and radar approach control facilities) and terminal equipment (including automation and BRITE displays) must receive an appropriate degree of modernization to sustain cost-effective operations prior to this transition. Moreover, guidance, surveillance, weather, and communications aids must receive upgrades and service improvements (as described in Chapter IV) to optimize system performance or provide the foundation for service improvement through the next decade.

The Flight Service and Weather Systems portion of the NAS Plan contains improvements required to modernize flight and weather services which also affect terminal system performance. Foremost among them: ICSSs for towers replace obsolete and expensive leased systems, AWOS systems for airports improve weather observations, more LLWAS systems alert controllers of potentially hazardous wind conditions, and TDWR systems alert controllers of microbursts and other hazardous wind shear conditions.

Projects in Chapter V, Interfacility Communications Systems, improve the reliability, efficiency, and cost-effectiveness of communicating digital and voice information between towers, ACFs, and remote facilities. This chapter also implements television microwave links needed to provide radar data to satellite towers.

Chapter VI, Maintenance and Operations Support Systems, improves the maintenance, flight inspection, and overall system support of the NAS, specifically: improving the monitoring of airport facilities, upgrading of airport power systems, and enhancing the national systems support capability.

TERMINAL AUTOMATION

The upgrades and system improvements to the terminal automation system included in this chapter are "sustaining" in nature. They assure that the terminal air traffic control systems can and will operate safely and efficiently until replaced.

The ARTS IIIA systems are receiving software enhancements to predict potential flight conflicts more accurately and reduce the nuisance alarms that impact the usefulness of this function during peak traffic hours. ARTS IIIA systems received additional memory to accommodate traffic growth. Power conditioning systems are being added at ARTS IIIA sites (see Chapter VI). New digital displays at New York TRACON will allow for relocation of existing displays to provide interim training enhancements at other facilities. In order to sustain the national system support capability, a second ARTS system has been purchased for the FAA Technical Center.

The ARTS II facilities will be upgraded to support tracking capabilities and enhancements similar to those provided in the ARTS III. New displays have been bought and installed at TRACAB locations. ARTS II facilities have been interfaced with the ARTCC computers to provide automatic hand-offs and interchange of flight plans. The TPX 42 beacon decoding systems will be replaced with ARTS IIA to provide standard levels of automated display capability.

COMMUNICATIONS

Communications improvements complement the advances in automation, and use in the towers will continue indefinitely. The automatic terminal information service recorders and voice recorders will be replaced with highly reliable units. A voice communications control and switching system will be installed to maximize the benefits of the tower suites.

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OTHER FACILITIES AND EQUIPMENT

Other facility and equipment sustaining modernization efforts are required. Relocation of towers and some TRACONs will continue due to airport construction. Some low-activity VFR towers will be closed or offered to local governments for continued operation. Mechanical and structural improvements are being made to tower buildings to assure continued use into the 2000s. Maintenance-intensive BRITE systems at all airport towers with radar displays will be replaced and new systems added at satellite tower locations.

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PROJECTS	IMPLEMENTATION	
	FIRST	LAST
TERMINAL AUTOMATION		
ARTS III		
1. Enhanced Terminal Conflict Alert	1986	1988
2. ARTS IIIA Assembler	PROJECT	COMPLETE
3. Enhanced Target Generator (ETG) Displays (ARTS III)	1989	1990
4. Additional ARTS IIIA Memory	PROJECT	COMPLETE
5. Additional ARTS IIIA Support at the FAA Technical Center	PROJECT	COMPLETE
ARTS II		
6. ARTS IIA Enhancements	1988	1989
7. ARTS II Displays	PROJECT	COMPLETE
8. ARTS II Interfacility Interface	PROJECT	COMPLETE
9. ARTS IIA Interface with Mode S/ASR 9	1988	1991
COMMUNICATIONS		
10. Automatic Terminal Information Service (ATIS) Recorders *	1988	1988
11. Multichannel Voice Recorders *	1986	1992
12. Tower Communications System	1991	1997
OTHER FACILITIES AND EQUIPMENT		
13. ATCT/TRACON Establishment, Replacement, and Modernization	1981	1992
14. VFR ATCT Closures	1981	1992
15. Combine Radar Approach Control into ARTCC	PROJECT	DELETED
16. Bright Radar Indicator Tower Equipment (BRITE)	1988	1991
17. TPX 42 Replacement	1988	1989
18. Sustain New York TRACON	1988	1990

* Depot Delivery Dates

PROJECT SUMMARY

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PROJECT 1: Enhanced Terminal Conflict Alert

Purpose: The present conflict alert software has desensitized specific areas to reduce excessive nuisance alarms. This project develops, tests, and implements software modifications which resolve problems related to nuisance alarms without desensitizing areas.

Reduction of nuisance alarms is required to maximize the effectiveness of the conflict alert function to the controller. Attainment of a minimal number of nuisance alarms requires optimum conflict detection in environments where larger numbers of aircraft are closely maneuvering, landing, and departing, and where simultaneous parallel approaches are regularly conducted.

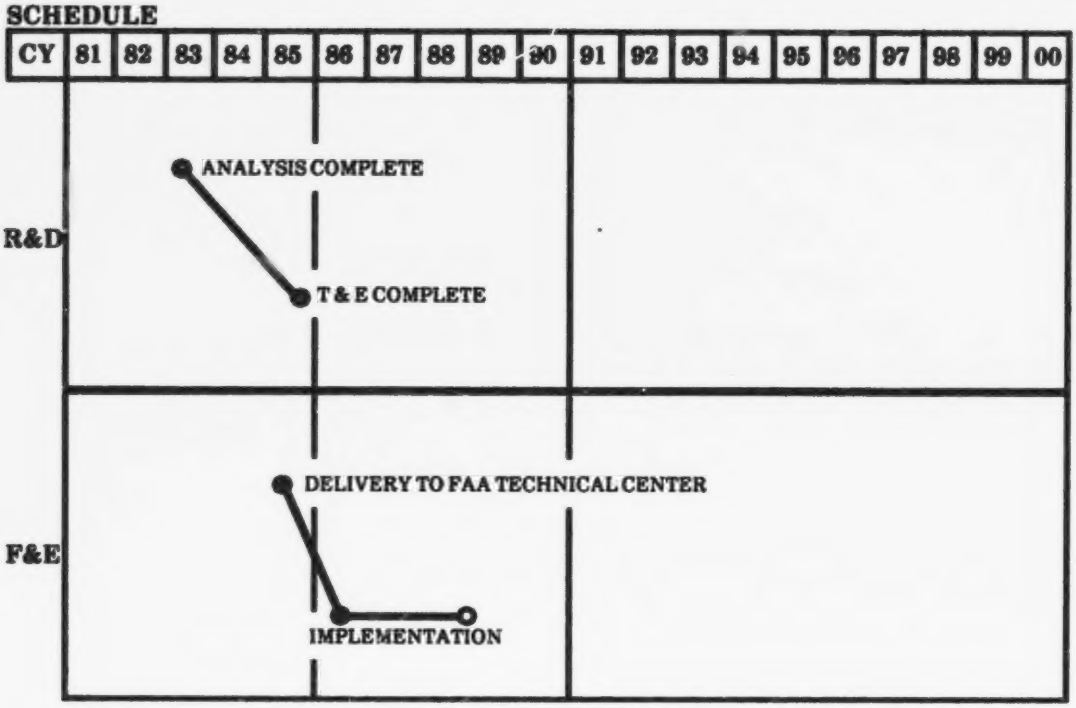
Approach: Software enhancements will be procured to resolve problems in conflict alert. Outstanding issues that require research and resolution are:

- Refinement of conflict alert processing so as to optimize processor and memory resources.
- Refinement of conflict alert inter-sensor processing (a major contributor to excessive nuisance alarms).
- Analysis and resolution of radar errors due to registration and alignment inaccuracies.
- Refinement of radar X-Y conversion.

Products: One software modification installed at 63 ARTS IIIA locations and the New York TRACON. The software modification package was delivered to the FAA Technical Center in mid-1985 for integration, on a site specific basis, into the operational program. Implementation began in mid-1986.

Related Projects/Activities: ARTS IIA Enhancements – the addition of conflict alert to ARTS II is a program that is similar in function.

SCHEDULE



PROJECT 3: Enhanced Target Generator (ETG) Displays (ARTS III)

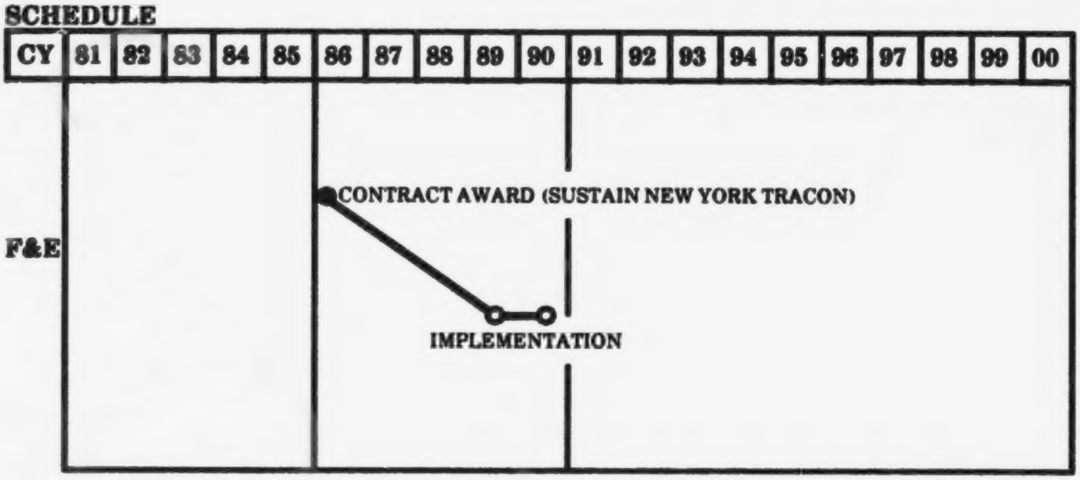
Purpose: Currently, not all ARTS III facilities have sufficient capability to perform on site simulation training for controllers. This program provides sites with additional displays to enhance the air traffic controller on site training.

Approach: The displays being removed and replaced at the New York TRACON will be refurbished by the FAA and relocated to other ARTS IIIA facilities to provide needed training capability.

Products: 44 displays.

Related Projects/Activities: Sustain New York TRACON

SCHEDULE



PROJECT 6: ARTS IIA Enhancements

Purpose: This project will enhance ARTS II to add beacon tracking, MSAW, conflict alert, and a training target generator. Conflict alert and MSAW are required to alert controllers to potential hazardous conditions when less than standard separation exists. The training target generator provides the capability to train controllers in selected and varied control situations in a simulated environment.

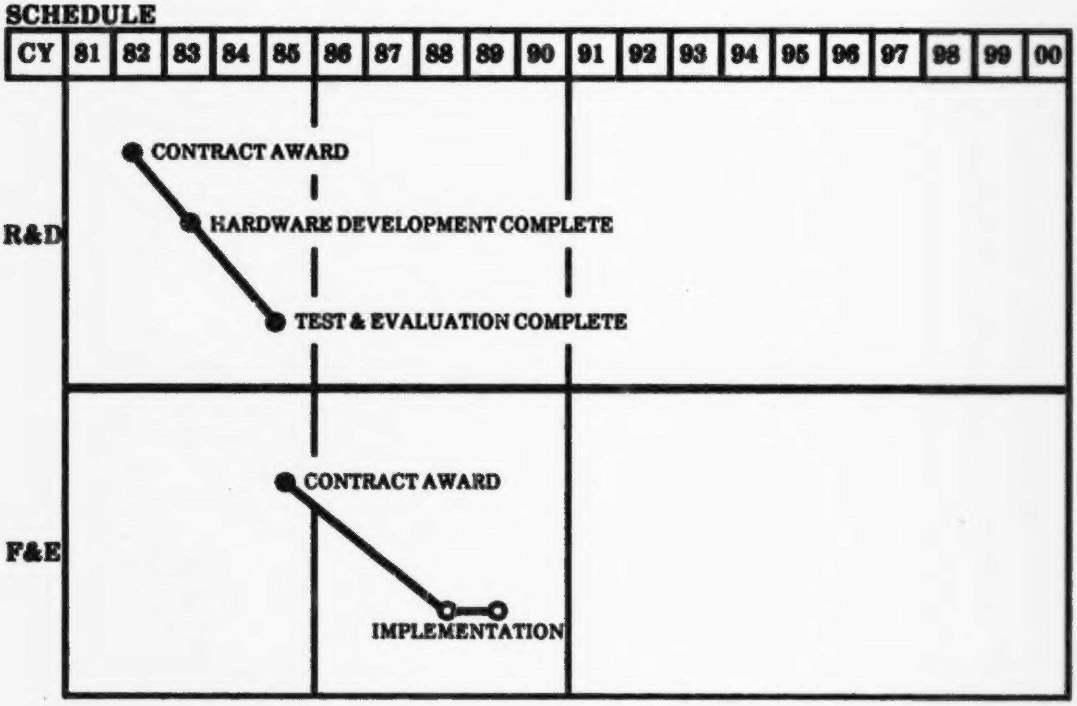
Approach: Procure equipment, software, and services to provide conflict alert, minimum safe altitude warning (including cartographic support), training target generator, and tracking for ARTS II. Software will be developed using techniques and methods currently in use in the ARTS II and ARTS IIIA systems.

Products: Enhancements to 95 operational and support systems.

Related Projects/Activities:

- Enhanced Terminal Conflict Alert – The ARTS IIA conflict alert will utilize the results of the ARTS IIIA conflict alert developmental effort.
- TPX 42 Replacement – TPX 42 replacement products are included under the same contract as ARTS IIA enhancement.

SCHEDULE



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PROJECT 9: ARTS IIA Interface with Mode S/ASR 9

Purpose: This project will develop the hardware and software that will allow the ARTS IIA to receive and process digital data from terminal sites equipped with Mode S/ASR 9 surveillance equipment. This interface will allow the ARTS IIA to operate with common digitizer (CD) formatted radar data but will not utilize the Mode S capability for discrete addressing or data link communications.

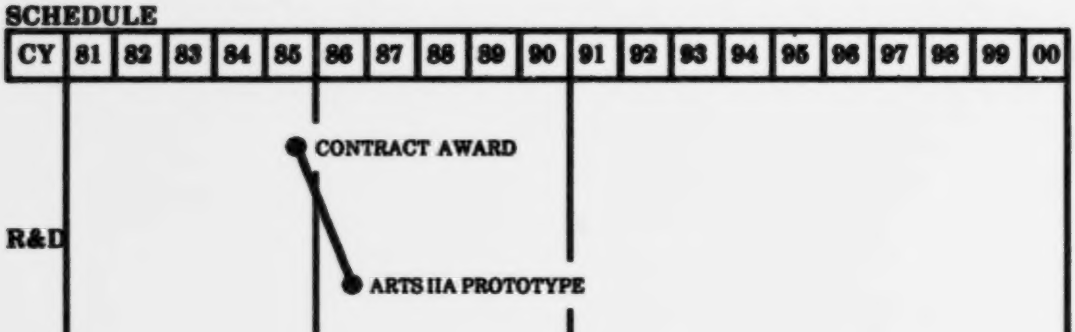
Approach: Develop, test, evaluate, and implement hardware and software modifications so that those ARTS IIAs operating with Mode S/ASR 9 can receive CD-type messages and reformat the data to provide the ATC display required for ARTS operation.

Products: One interface modification package for each ARTS IIA site which will interface with Mode S/ASR 9 facilities.

Related Projects/Activities:

- Mode S – Provides Mode S equipment to be interfaced to ARTS IIA.
- Terminal Radar (ASR) Program – Provides ASR 9 equipment to be interfaced to ARTS IIA.

SCHEDULE



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PROJECT 10: Automatic Terminal Information Service (ATIS) Recorders

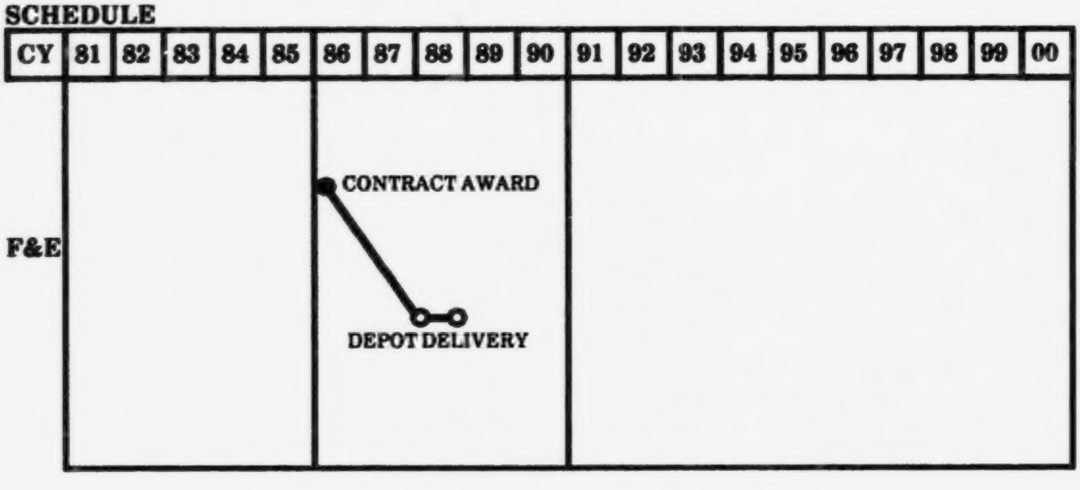
Purpose: ATIS recorders are used to transmit weather and airport conditions to pilots in controlled terminal areas. Existing ATIS recorder types are electromechanical with operational reliability problems. Solid-state ATIS recorders are cost beneficial because of maintenance and space advantages. Approximately 10 percent of the obsolete recorders have already been replaced with minimal maintenance solid-state models. Such highly reliable solid-state units are needed at all facilities.

Approach: A contract for solid-state ATIS recorders has been awarded and deployment is scheduled to begin in early 1988. Due to similarities in equipment, the ATIS and Hazardous In-Flight Weather Advisory Service (HIWAS) recorder procurements have been combined.

Products: A total of 450 units will be procured to replace existing TRC 89s.

Related Projects/Activities: Hazardous In-Flight Weather Advisory Service (HIWAS).

SCHEDULE



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PROJECT 11: Multichannel Voice Recorders

Purpose: Multichannel voice recorders are utilized to record all voice communications between air traffic controllers and pilots. The existing 5- and 9-channel recorders used at ATCTs and FSSs have serious operational reliability, maintenance, and supply/support problems. The high-capacity 152-channel recorders presently in use at the ARTCCs do not have sufficient capacity to support the ACF operation. In addition, they are experiencing supply/support problems because their production has been discontinued by the manufacturer.

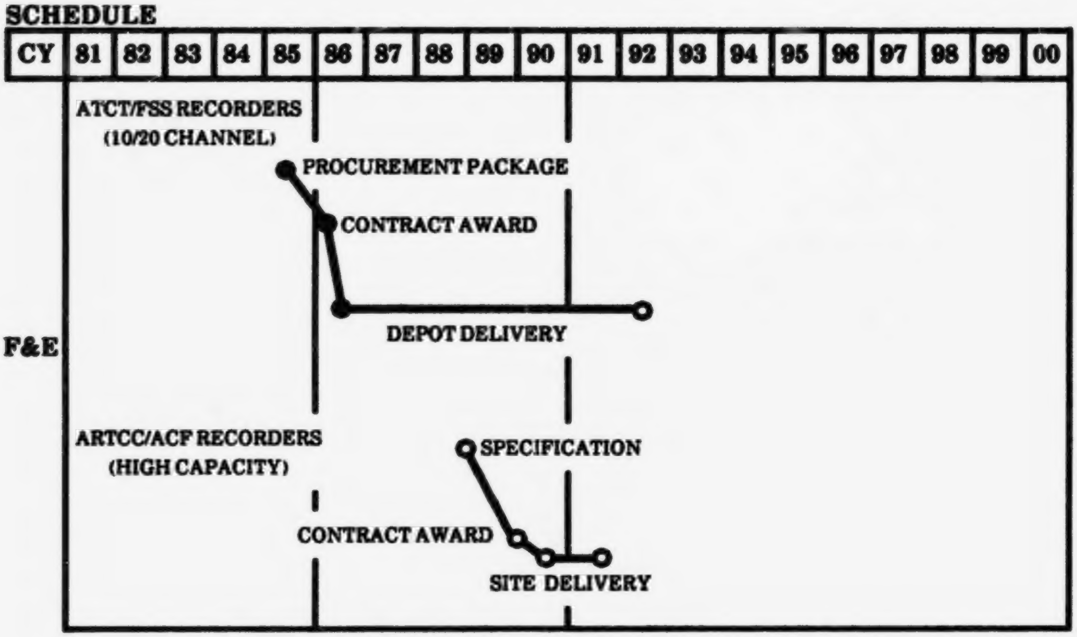
Approach: 10- and 20-channel recorders are to be used for replacement of the remaining 5- and 9-channel equipment, and for establishment, relocation, and modernization of ATCTs as necessary. Additionally, certain FSSs and AFSSs will also receive the 10- and 20-channel recorder units. High-capacity recorder systems will be procured for the ARTCCs/ ACFs.

Products:

- 258 10- and 20-channel units for replacement of existing 5- and 9- channel units at ATCTs and FSSs.
- 150 10- and 20-channel units for new establishments, relocations, and depot spares.
- 34 high-capacity units for ARTCCs/ACFs.

Related Projects/Activities: All voice communications switching systems at air traffic control facilities, such as VSCS, ICSS, and TCS, will require recording equipment.

SCHEDULE



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PROJECT 12: Tower Communications System

Purpose: This project will provide a modern voice communications switch and control system which meets the needs of future tower operations. Replacement of the present system with modern equipment will significantly improve the operational and maintenance aspects of tower communication systems.

Approach: Communications switch and control systems currently in the airport traffic control towers (ATCT) are either leased systems with limited operational features or the more modern integrated communications switching systems (ICSS). ICSSs, which are displaced by TCS, will be relocated to towers that do not have a modern voice switch. The TCS will be designed to operate with the TCCC, but may operate independently at those locations where a TCCC is not installed.

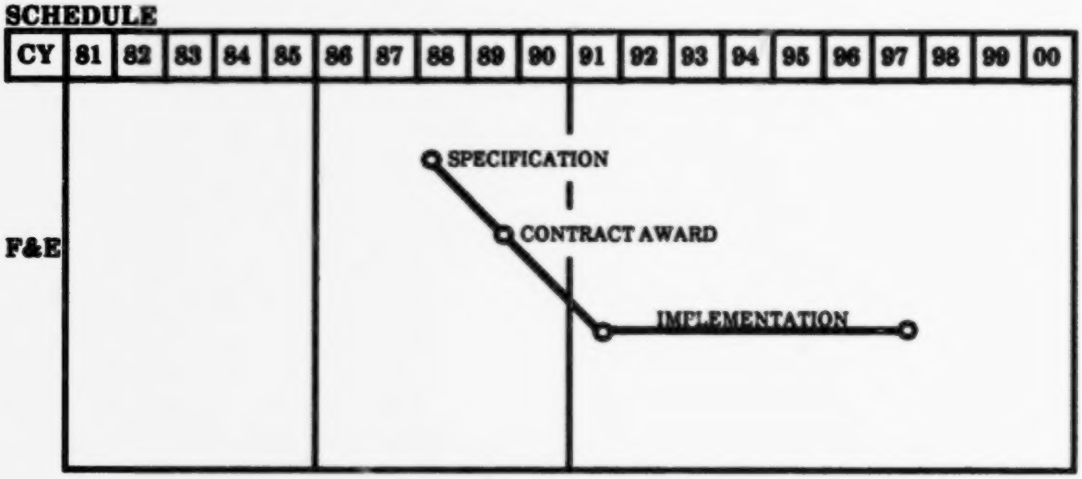
Products:

Approximately 300 new TCSs will be procured and installed in towers.

Approximately 130 ICSSs will be relocated to towers that do not presently have a modern voice switch.

Related Projects/Activities: ICSS, Radio Control Equipment, RMMS and Advanced Automation System.

SCHEDULE



PROJECT 13: ATCT/TRACON Establishment, Replacement, and Modernization

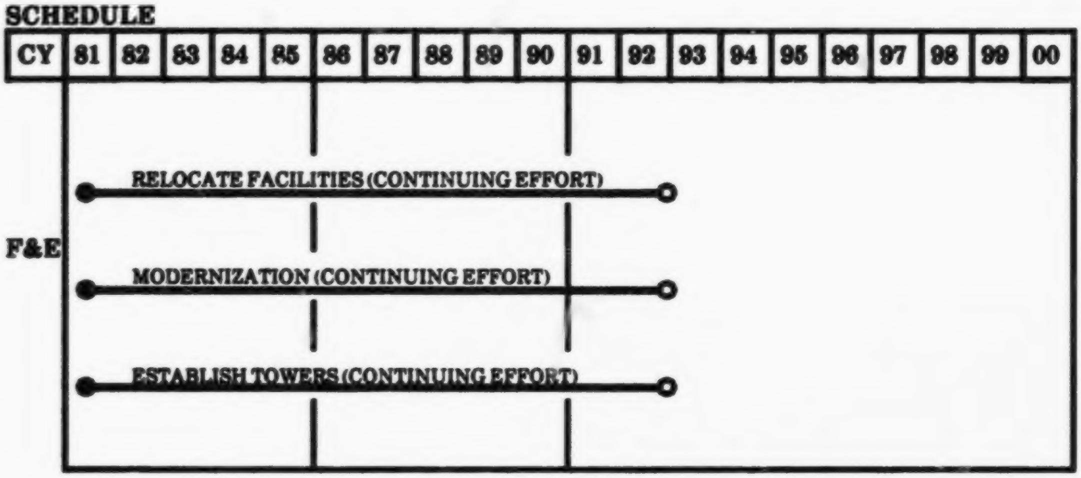
Purpose: This project provides for establishment of terminal ATC facilities and takeovers of sponsor-owned towers that meet airway planning standards cost effectiveness criteria, and modernization or replacement when necessary, e.g. increase of tower cab height to improve visibility. It also includes modernization of existing towers to add operating positions; establish administrative and training space; upgrade TRACABs to TRACONs; replace obsolete or unreliable engine generators and heating, ventilating, and air conditioning (HVAC) systems.

A number of existing facilities will surpass their 20 year design life prior to the year 2000. Thus, major costs will be incurred to replace or upgrade environmental systems and rehabilitate operational and administrative spaces.

Approach: FAA headquarters develops national standards and makes national environmental support buys. Construction will be by regional contracts supported by national architectural engineers for site-specific designs. This project will not include establishment of TRACON base buildings after 1984 due to the area control facility (ACF) program. Unusual circumstances and/or overriding operational considerations may dictate deviation from this philosophy. If such circumstances occur and justification can be made, then site-specific proposals for TRACON replacement will be considered.

Products: Approximately 30 additional ATCT facilities will be candidates for replacement over the next 6 years (1987 through 1992). An average of 5 per year is planned. Approximately 100 facilities have been identified as candidates for some level of major modernization. Additionally, over 200 facilities have been identified as candidates for some level of minor modernization; i.e., tower console wind instruments, clocks, digital altimeter setting indicators, etc. It is anticipated that 10 additional sites will be considered for either tower establishments or the assumption of an existing facility. In addition, seven mobile ATCTs will be acquired for basing within certain regions and the FAA Depot. These units will be used for spontaneous response to disasters, shutdowns, and events such as airshows and fly-ins at non-towered airports.

Related Projects/Activities: Area control facilities, tower position consoles, ICSS, and TCS.



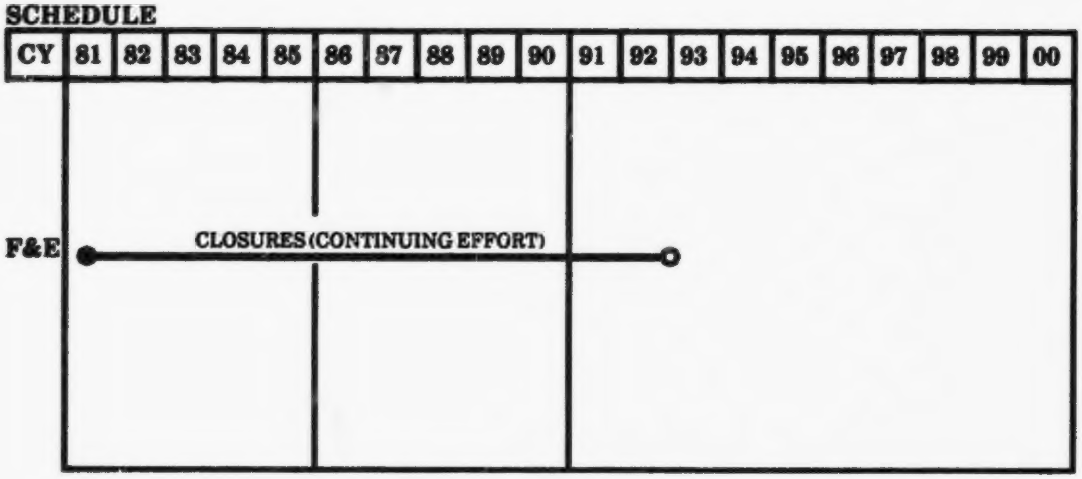
PROJECT 14: VFR ATCT Closures

Purpose: This project will improve cost-effectiveness and operational productivity of the federally operated ATC system. Air Traffic personnel resources would become available for use at other locations.

Approach: Subject to final approval, towers that do not meet existing retention criteria will be closed. Local governments will be given the opportunity to assume responsibility for operation of closed towers. Modular tower structures that are not operated by local governments may be mothballed and made available for use at a later date or possibly another location. FAA may share costs of facilities if operated by others.

Products: The towers identified by the criteria for potential closure will be reviewed in-depth and appropriate action initiated as necessary. Reviews are conducted annually.

Related Projects/Activities: None.



PROJECT 16: Bright Radar Indicator Tower Equipment (BRITE)

Purpose: This project will replace the BRITE systems which have been in the field since 1967 and do not provide reliable service. It will also provide alphanumeric display systems for satellite airport traffic control towers (ATCT) that presently do not have radar. Digital scan converter systems are inherently much more stable and reliable than the plan position indicator (ppi)/TV camera converters in use today. Approximately 60-70 percent maintenance workload reductions will result.

Approach: Procure BRITE systems which take advantage of digital scan converter technology. This project will replace all BRITE and Bright Alphanumeric and Numeric Generator Conversion Equipment with the new system. The new system will also be installed at qualifying satellite towers. This project is a joint FAA/DOD procurement with the USAF as the procuring agency.

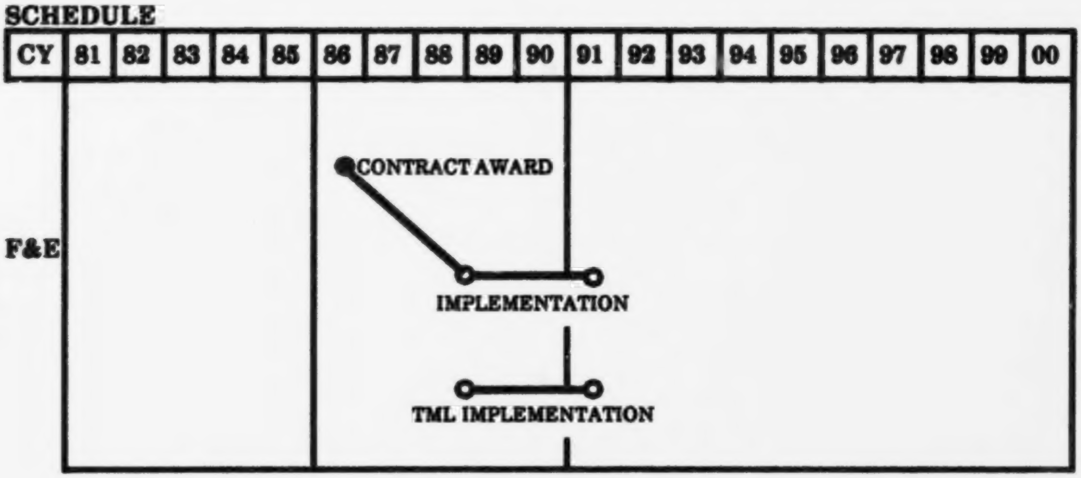
Television Microwave Links (TMLs) (both terminal and repeaters, as required) will be procured by the regions to provide service to 40 satellite towers.

Products:

● Replace BRITE I/II/IV	347 Systems
● Establish ASR/ATCT	9 Systems
● Establish Satellite ATCTs	40 Systems
● System Support	5 Systems

Related Projects/Activities: Data Multiplexing and TPX 42 replacement program.

SCHEDULE



PROJECT 17: TPX 42 Replacement

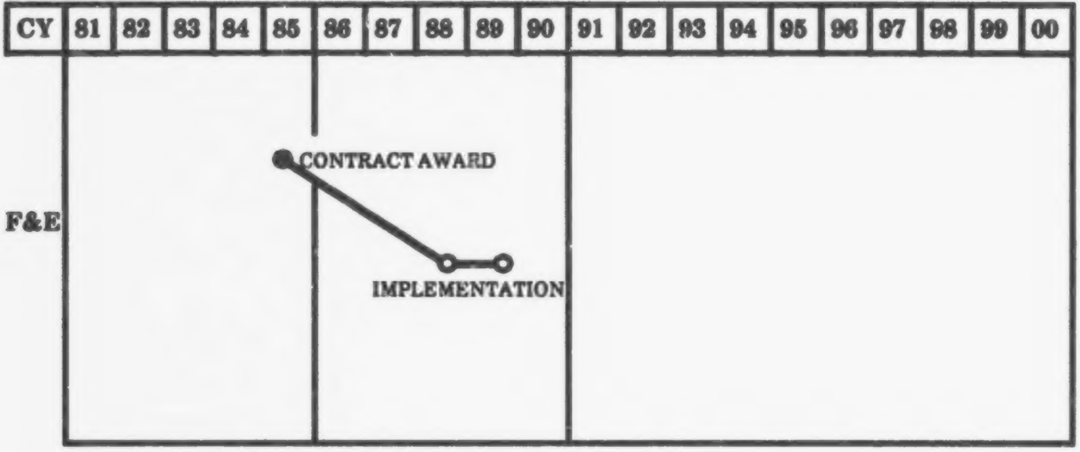
Purpose: The TPX 42 systems were installed around 1972 and do not provide ATC features that are necessary in today's environment (i.e., alphanumerics, tracking, conflict alert, test target generator, and interfacility interface). This program replaces TPX 42s and ensures service until the area control facilities are established. The replacement system must provide those standard services and allow for expected growth in traffic.

Approach: Procure 33 ARTS IIA-type systems, including displays. Displays procured for the TRACON environment will be plan position indicators (ppi). BRITEs will be used at TRACABs, procured as additions to the BRITE replacement contract. These systems are being purchased as part of the ARTS IIA Enhancements contract.

Products: 33 TPX 42 replacement systems.

Related Projects/Activities: ARTS IIA, BRITE replacement program, and Data Multiplexing.

SCHEDULE



PROJECT 18: Sustain the New York TRACON

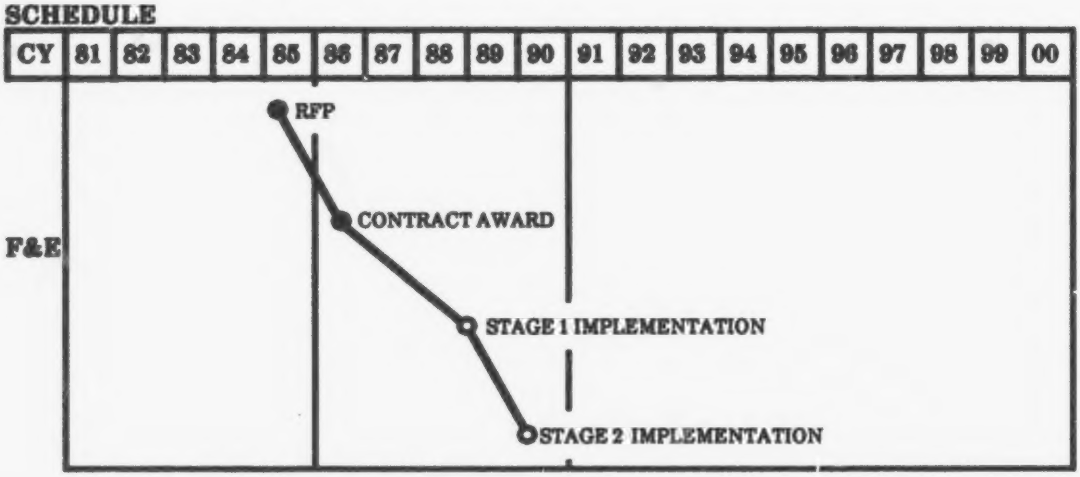
Purpose: The New York TRACON ARTS IIIA system must continue to provide the current level of reliability and the required air traffic control services until replacement by the advanced automation system. However, the New York TRACON ARTS IIIA is a unique system that has reached the operational design limit of its hardware architecture and, with software modifications, can only provide satisfactory service up to the late 1980s in the face of increasing aircraft operations. This project will develop and implement a modified system architecture with appropriate hardware/software changes to satisfy air traffic requirements until replacement.

Approach: Provide the necessary modifications and additional hardware/software to implement this project in two stages. Stage 1 will install intelligent displays, and Stage 2 will provide the system architecture modifications to allow increased capacity to meet operational requirements.

Products: A modified ARTS IIIA architecture with additional hardware/software installed at the New York TRACON. This will involve replacement, modification, and/or additional processors, memory, intelligent displays, and software.

Related Projects/Activities: Enhanced Target Generator (ETG) Displays (ARTS III). The displays currently in use at the New York TRACON will be relocated to other ARTS III locations to provide needed training capability.

SCHEDULE



FLIGHT SERVICE AND WEATHER

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FLIGHT SERVICE AND WEATHER SYSTEMS

In 1981, there were more than 300 FAA flight service stations (FSS) offering a broad range of preflight and in-flight services especially aimed at general aviation (or nonairline pilots). These services included:

- Accepting and closing flight plans.
- Conducting preflight weather briefings.
- En route communications with pilots flying under visual flight rules.
- Assisting pilots in distress.
- Disseminating aviation weather information.
- Monitoring air navigation radio aids.
- Originating notices to airmen.
- Working with search and rescue units in locating missing aircraft.

At certain locations, flight service stations take weather observations, issue airport advisories, provide en route flight advisory service, and advise customs and immigration officials of transborder flights. The stations also have communications equipment for relaying information to towers and air route traffic control centers and for various emergency services.

Flight service stations range in size from very small facilities to large ones employing approximately 100 people. The buildings housing the stations vary in size, design, and age.

Of all the FSS services, none is more important to safety than those related to weather. The FAA aviation weather system collects weather information and distributes it to both pilots and agency operations personnel. Weather information is collected largely with electromechanical devices that give wind velocity, temperature, dew point, ceiling, visibility, and altimeter settings. Facsimile weather maps and medium speed collection/display equipment are used.

FAA long-range surveillance radars are also used to give two levels of contours to outline weather on en route radar displays for controllers and for center weather service unit (CWSU) meteorologists at the en route centers. Other aviation weather information comes from the National Weather Service; Aeronautical Radio, Inc. (ARINC); pilot reports; and observations made by agency personnel.

To get weather information to pilots, the agency depends on telephones and radio voice broadcasts, including advisories made over VOR radio stations used for navigation. At some locations, voice recordings disseminate mass weather information. For some preflight briefings and in-flight advisories, direct communications between the pilot and flight service station specialist are used.

All of these functions continue to be performed similarly today. Flight and weather services provided federally, locally, or by the private sector are critical to the safety of today's system.

THE NEW APPROACH

Flight and weather services will be improved for pilots by giving them direct access to weather information and flight delay information, both in the air and on the ground, and simplifying flight plan filing. Aviation weather service is being improved in quality and timeliness, thus improving safety and saving fuel.

Automation and improvement of flight service stations and related aviation weather systems are being made to allow consolidation of facilities, reducing operating costs significantly. Automation of weather radar and current weather information is continuing and will provide more usable and current information to en route and terminal controllers and flight service station specialists.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

In the interval between 1981 and 1985, the process of consolidating existing flight service stations and the implementation of automated flight service was begun. During this initial effort, considerable progress has also been made in the acquisition of improved weather information, the development of improved dissemination techniques, the definition of weather-related automation requirements, the development of automated flight services, and the selection of locations for automated flight service stations.

The existing national network of FAA and National Weather Service radars has been retrofitted so that six levels of weather contouring, outlining storms, are now displayed to en route meteorologists at air route traffic control centers and flight service specialists at flight service stations. Satellite-originated weather images providing additional information on cloud cover and weather systems have been provided to some of these locations through the implementation of facsimile recorders.

Other weather systems include low level wind shear alert (LLWAS) equipment, which detects hazardous wind conditions. LLWAS is being provided to an increased number of airports. Whereas, 59 systems were previously in operation; by the end of 1985, approximately one-half of the 51 additional units purchased had been deployed. Ongoing research has determined that the number of wind sensors associated with each system should be increased to enhance performance.

The demonstration of automated weather observing systems (AWOS) was completed. These systems provide efficient and low-cost surface observation data critical to airport operations. Specification of the production system was completed and the acquisition approach was determined.

Improvements in flight and weather information dissemination techniques are underway. Limited direct access to flight services is being provided to pilots through the implementation of a computer-generated interim voice response system (IVRS). This system was implemented in 1985 and permits pilots on the ground to retrieve information, via telephone, from an automated weather data base.

Enhancements to the availability of in-the-air weather information are also proceeding. The concept of broadcasting prerecorded hazardous in-flight weather advisories (HIWAS) over VORs was demonstrated and the acquisition process for a nationwide capability started. The dissemination of weather information from the flight service specialist to the en route pilot will also be improved. Equipment which establishes a clear voice communication channel, at 18,000 feet and above, has been purchased. This enhancement in en route flight advisory service (EFAS) can also be used for pilot reports.

The acquisition of automation aids for flight service specialists was well into production. The selection of 60 locations for automated flight service stations has been accomplished.

The deployment of an enhanced international and domestic NOTAM system was completed. Development of the architectural elements which comprise the weather processing capabilities of the future has started. New processors will enhance the information available to air route traffic control center meteorologists and to all system users.

The acquisition of a design and prototype of a central weather processor (CWP) started in early 1985. This processor stores weather data from all sources, including future systems such as Doppler weather radar, and creates tailored weather products.

The requirements for a weather communications processor, which supports the transmission of weather products via Mode S data link, were defined.

Other improvements to the flight service system include the procurement of new communications switching systems and the replacement of all teletypewriter equipment.

NEAR TERM (TO 1990)

During the near term, the majority of on-going planned improvements previously described will be completed or near completion.

A majority of the 61 fully automated flight service stations will be in service. Additionally, 110 low level wind shear alert systems will be in operation and procurement action and implementation of expanded systems will begin. Additional sensors will be added to the LLWAS, as appropriate, to improve detection of wind shear.

Most of the 160 interim automated weather observing systems will be implemented at non-towered airports. Data from these systems will be supplied both to air traffic control system personnel and synthesized into voice messages for broadcast.

AWOS broadcasts will complement other improved services such as hazardous in-flight weather advisories (HIWAS) and the enhanced en route flight advisory service (EFAS). HIWAS will be completed over the near term. Half of the EFAS outlets will be installed and procurement action for the remaining outlets initiated.

All of the 37 initial Model 1 flight service stations will be completed. Flight service automation systems (FSAS) will be implemented at additional locations. Along with integrated communications switching system (ICSS) capabilities, which include automatic call distribution, telephone answering, and recording of flight plans, and DUATS and weather graphics, the foundation for a more effective and responsive flight service system will be completed. Implementation of increased capacity Model 1 systems will begin.

The specification for replacement of the weather message switching center, which is the gateway to the National Meteorological Center products, was completed. Procurement action is scheduled for 1988. WMSC replacements will distribute NMC alphanumeric and graphics products throughout the NAS. FAA-gathered weather data such as that generated by AWOS will be available.

The first of the weather communications processors (WCP) will be implemented. Implementation of initial WCP services will be time phased to coincide with the deployment of the Mode S data link, and other elements of the weather information system. Aircraft, operating within Mode S coverage, will be able to acquire various types of weather and flight advisory information automatically as they become suitably equipped.

LONG TERM (TO 2000)

The National Weather Service (NWS) will provide automated surface observing systems (ASOS) at both towered and nontowered airports. All FSASs will be completed and additional EFAS outlets will be installed.

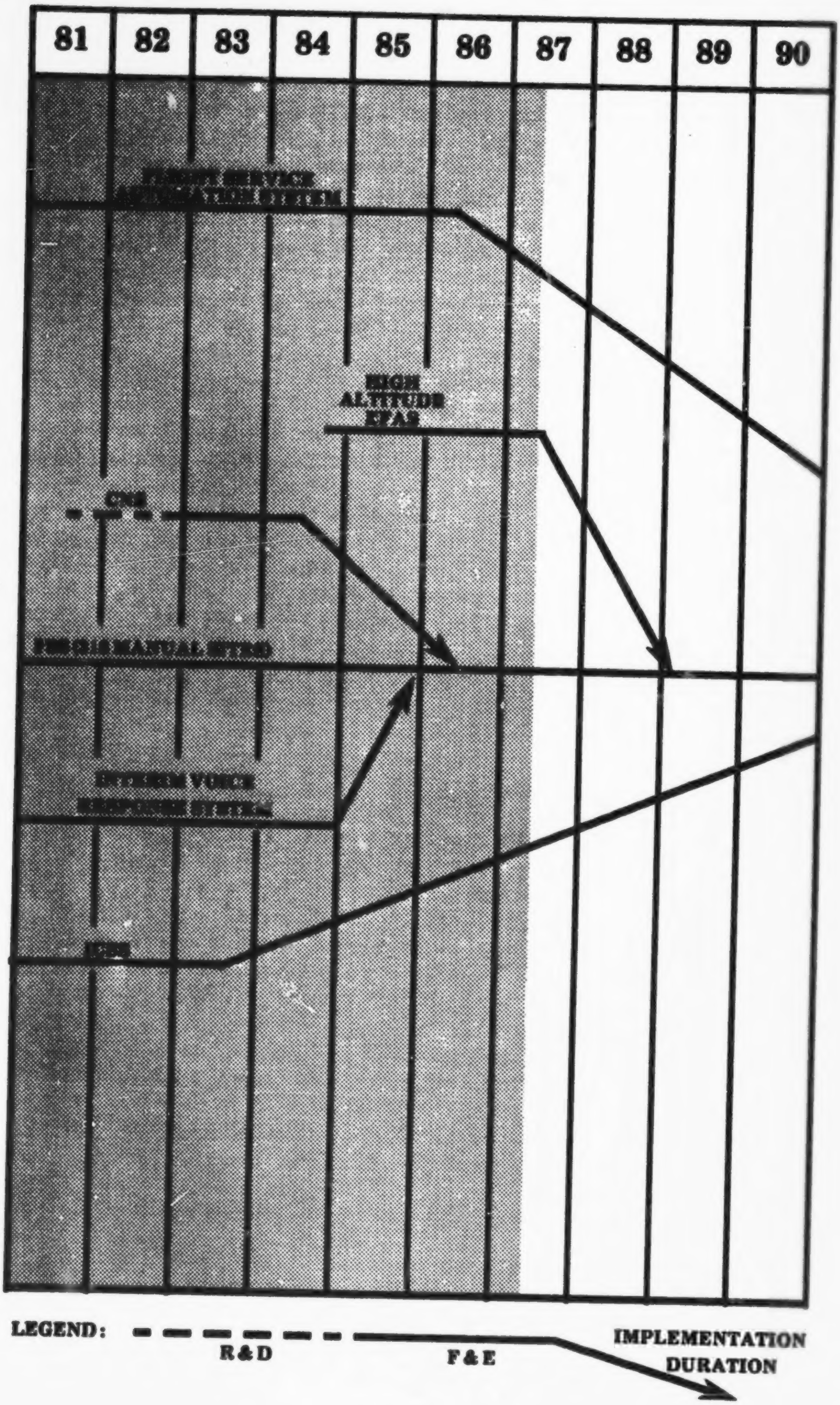
The Weather Message Switching Centers will be replaced with state-of-the-art equipment and central weather processors implemented.

A modernized system of flight services and weather services will have evolved. Users will have ready access to the required weather and flight information during all phases of flight operation. Access to preflight information will be accomplished via telephone to either flight service station specialists, the voice response system, or direct user access terminals. Access to in-flight information will be accomplished via radio to EFAS, via automatically updated continuous broadcasts, via the Mode S data link, and from specialists and controllers on an as-required basis.

A network of Doppler weather radars will be completed. This, in conjunction with ASR 9 and conventional radars, will improve the weather radar data base for real-time automated air traffic control functions. FAA-funded AWOS/ASOS, in combination with the weather service owned ASOS, will form the nationwide surface observation network. Satellite imagery information will continue to be used to provide weather information to flight service station specialists. Mode S data link coverage will be provided down to 6,000 feet altitude above mean sea level, providing automated service to aircraft at lower altitudes.

Improvements in wind shear detection using terminal Doppler radar will be implemented. Programs based on current research to determine the effects that wind, wind gradient, turbulence factor, temperature, temperature gradient, pressure, and humidity have on the generation, transport, and decay of wake vortices may result in the solution of wake vortex hazards. Improved information regarding rates of falling rain, sleet, snow, cloud heights, and lightning detectors for thunderstorm location may be provided.

The following diagrams and maps describe the evolution of the system.



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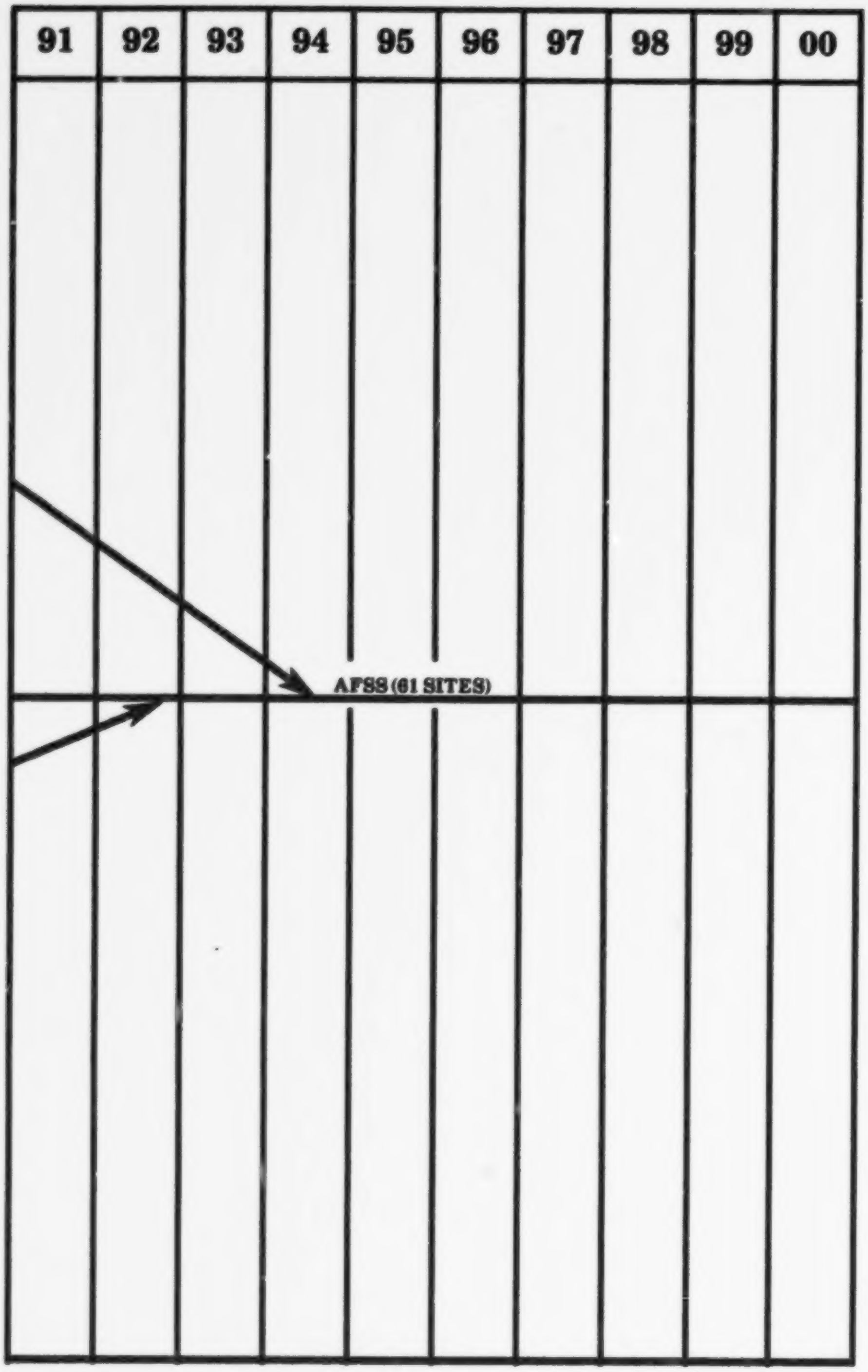

FLIGHT SERVICE SYSTEMS EVOLUTION

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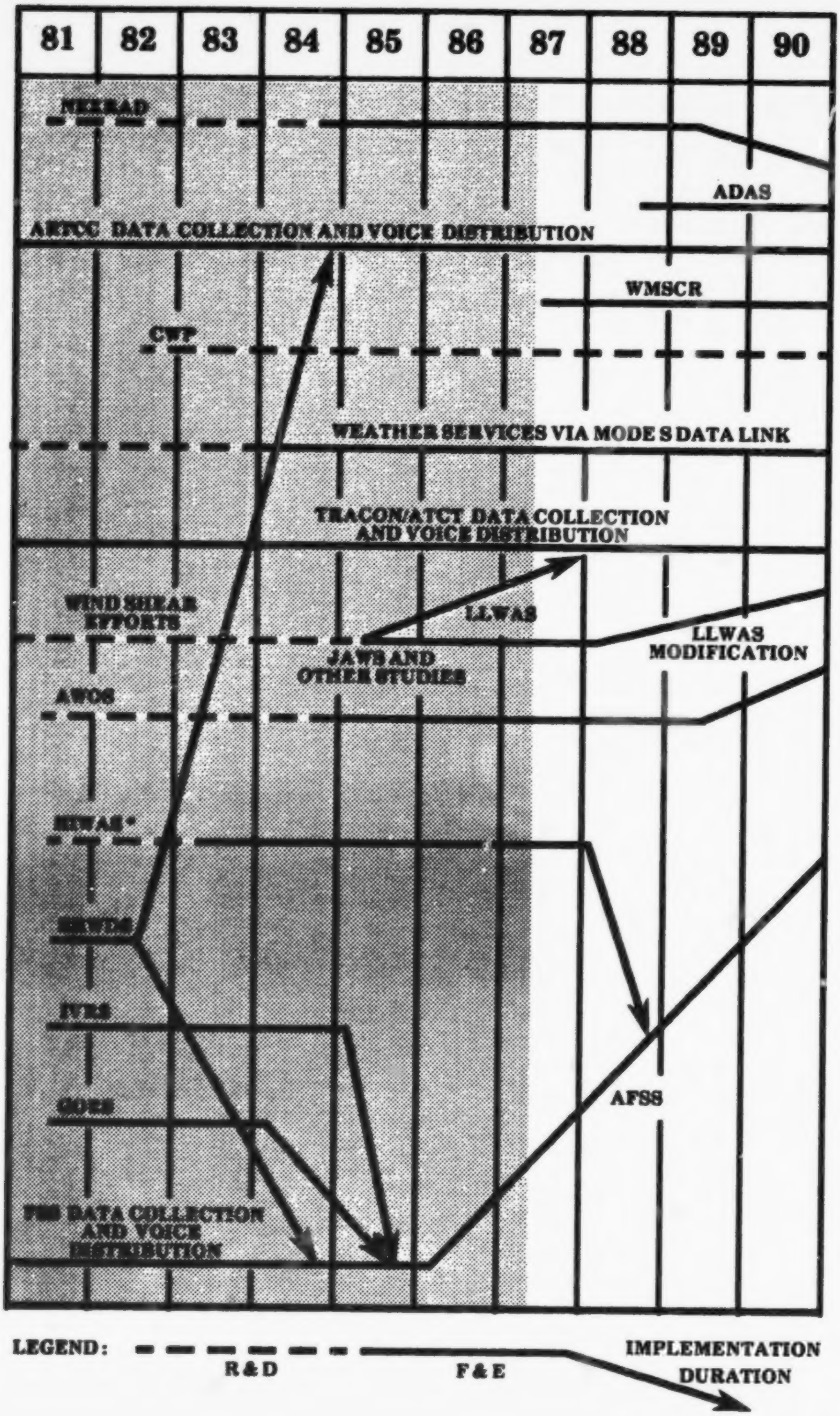
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ADAS
ARTCC DATA COLLECTION AND VOICE DISTRIBUTION
WMSCR
CWP
WEATHER SERVICES VIA MODE S DATA LINK
TRACON/ATCT DATA COLLECTION AND VOICE DISTRIBUTION
WIND SHEAR EFFORTS
LLWAS
LLWAS MODIFICATION
JAWS AND OTHER STUDIES
AWOS
HIWAS*
RRWDS
IVRS
GOES
FSS DATA COLLECTION AND VOICE DISTRIBUTION
AFSS
LEGEND:
R&D
F&E
IMPLEMENTATION DURATION

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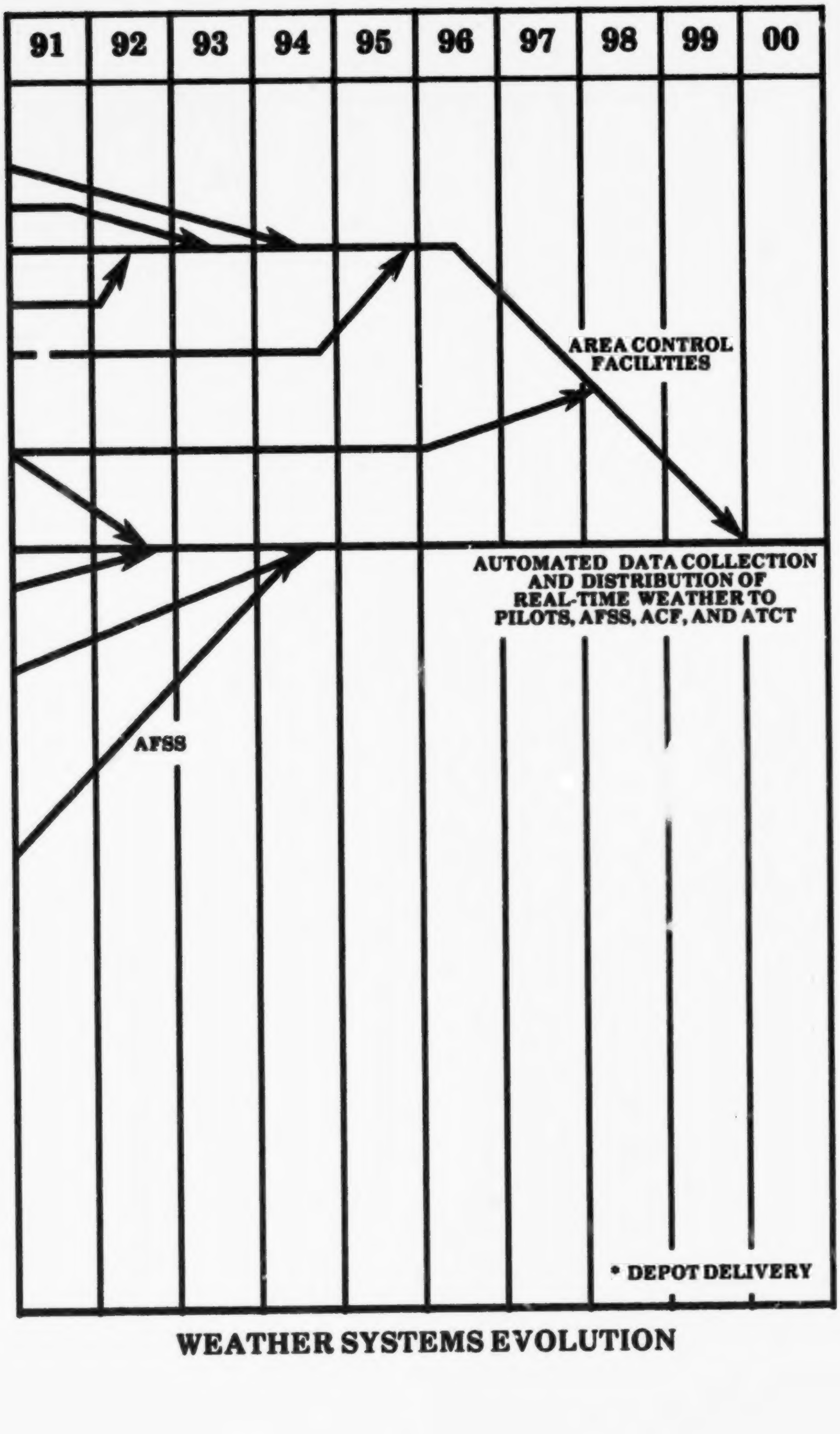
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AREA CONTROL FACILITIES
AUTOMATED DATA COLLECTION AND DISTRIBUTION OF REAL-TIME WEATHER TO PILOTS, AFSS, ACF, AND ATCT
AFSS
* DEPOT DELIVERY

WEATHER SYSTEMS EVOLUTION

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AUTOMATION OF FLIGHT SERVICE STATIONS AND FACILITY CONSOLIDATION IS UNDERWAY. 60 LOCATIONS HAVE BEEN SELECTED TO DATE.

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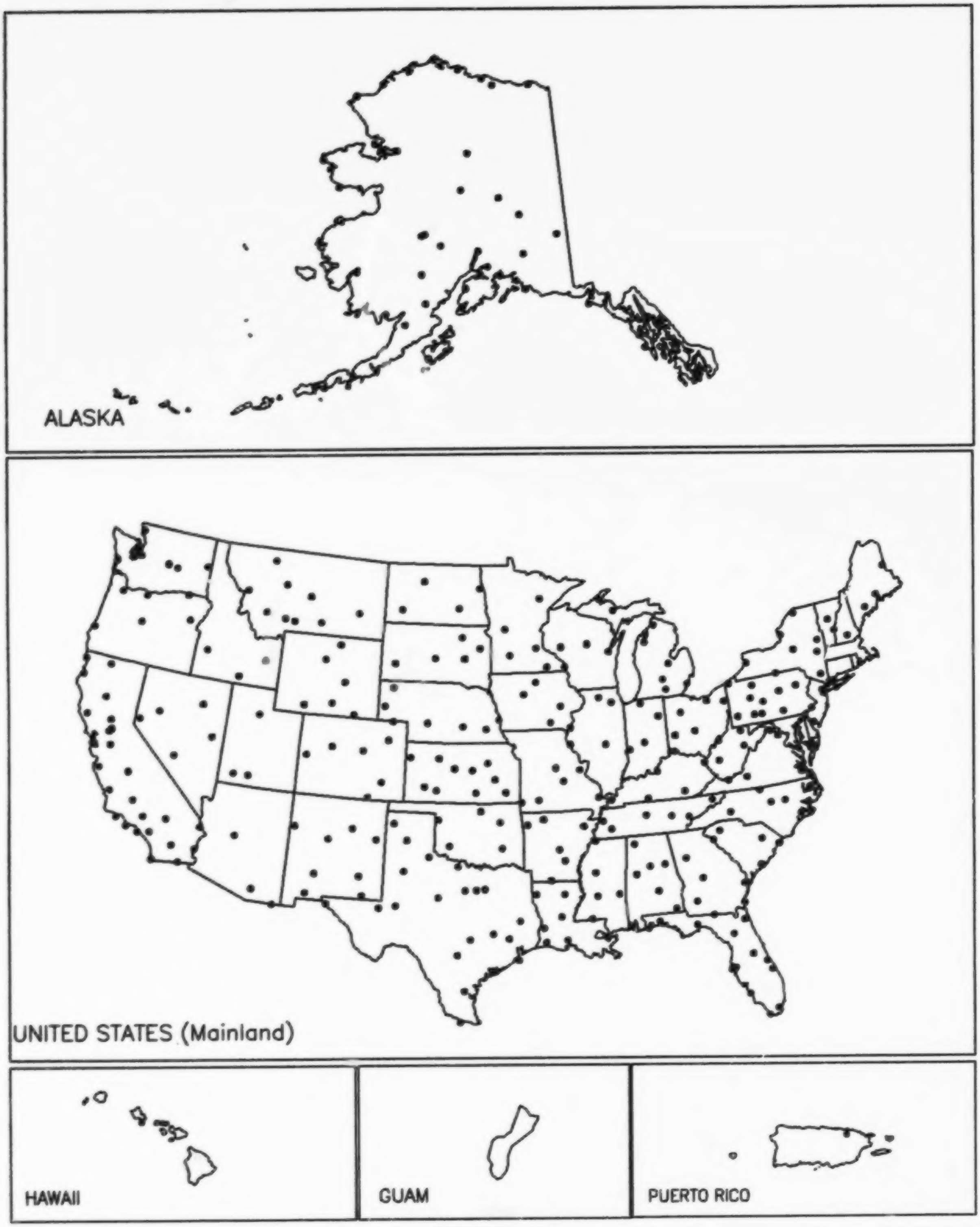
ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

**1985 SYSTEM
FLIGHT SERVICE STATIONS**

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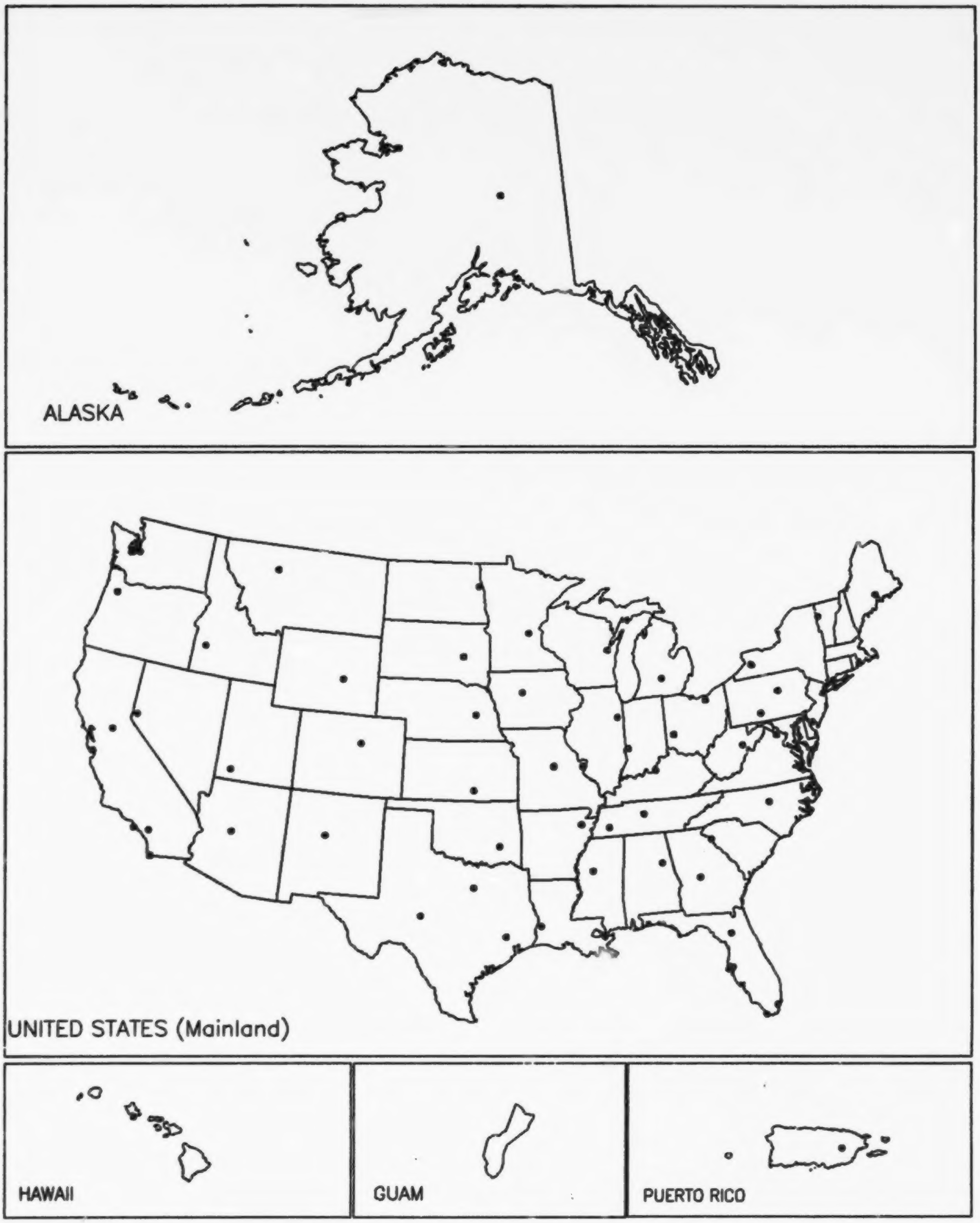
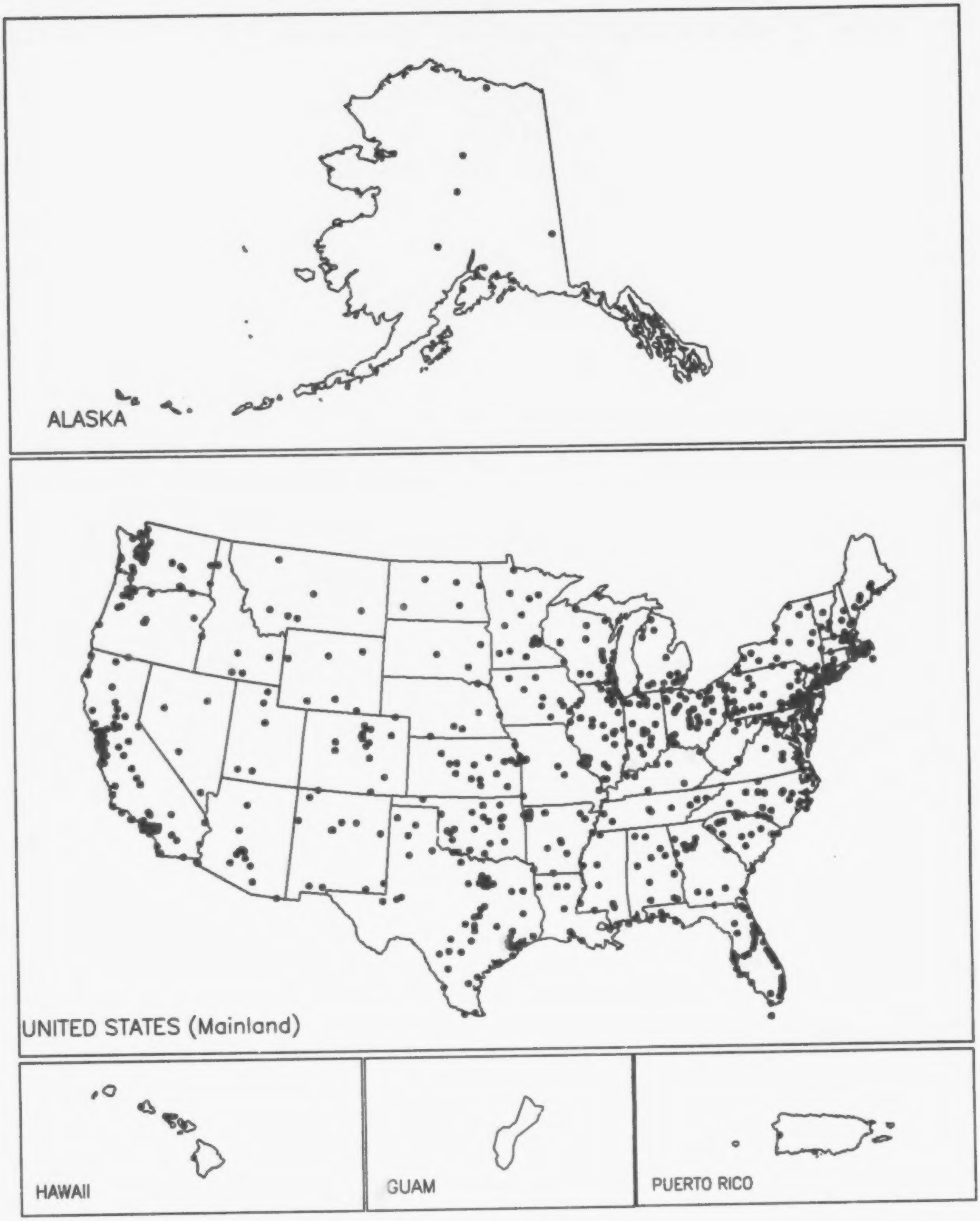
BY 1994, AUTOMATION AND FACILITY CONSOLIDATION WILL RESULT IN 61 FULL CAPACITY MODEL 1 AUTOMATED FLIGHT SERVICE STATIONS DRIVEN BY 23 FSDPSs.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1990 - 2000 SYSTEM
FLIGHT SERVICE STATIONS

BY THE YEAR 2000, AUTOMATED WEATHER OBSERVING SYSTEMS OR AUTOMATED SURFACE OBSERVING SYSTEMS WILL BE ESTABLISHED FOR 304 TOWERED AND 437 NONTOWERED AIRPORTS. ADDITIONALLY, 400 NONTOWERED AIRPORTS ARE EXPECTED TO INSTALL AUTOMATED WEATHER OBSERVING SYSTEMS WITH AIP FUNDS. WEATHER DATA WILL BE TRANSMITTED TO PILOTS OVER VHF/UHF COMMUNICATIONS OUTLETS, VIA MODE S DATA LINK, VIA TELEPHONE, AND AS PART OF THE ATIS MESSAGE. IN ADDITION, IT WILL BE PROVIDED TO CONTROLLERS AND THE WEATHER NETWORK OVER THE FAA TELECOMMUNICATIONS NETWORK.

AT PRESENT, THERE ARE NO PRODUCTION AWOS SYSTEMS IN THE FIELD. HOWEVER, PROTOTYPE AWOS SYSTEMS HAVE BEEN DEMONSTRATED AT FAA FACILITIES.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

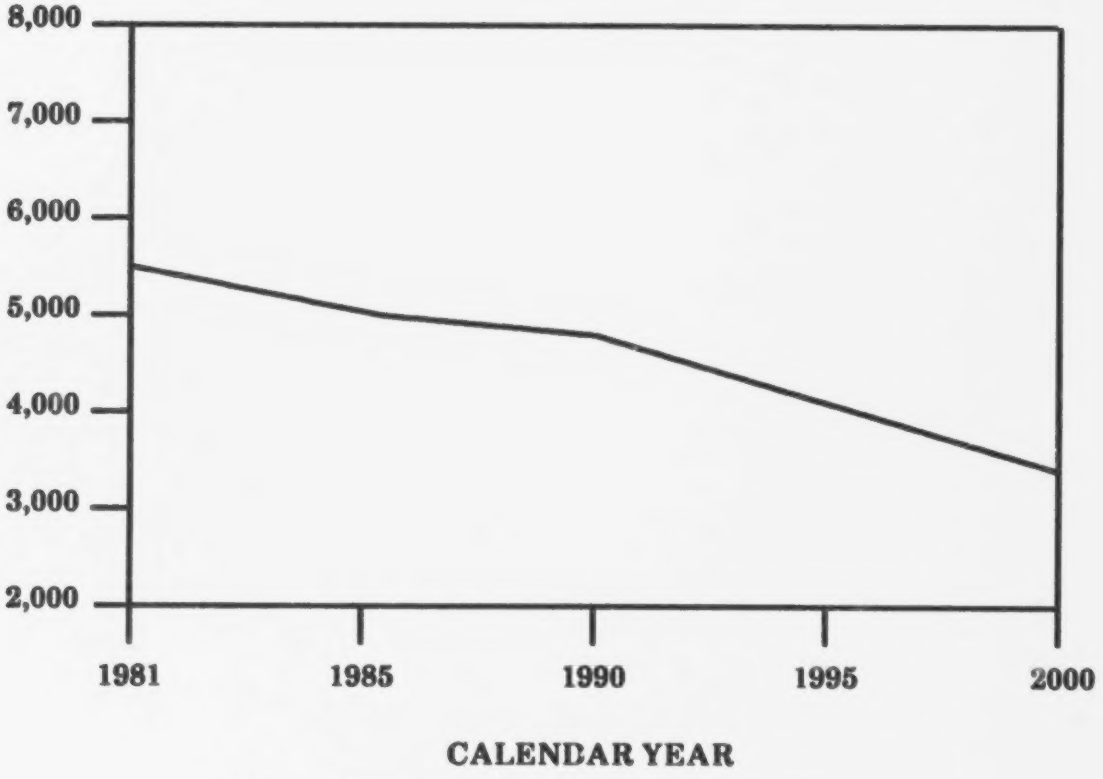
1990 - 2000 SYSTEM
AUTOMATED WEATHER OBSERVING SYSTEM

RETURN ON THE INVESTMENT

As a result of these planned actions, FAA operations costs will be significantly reduced; productivity will increase; and, most important, FAA's service to the user will be substantially improved.

FAA FIELD EMPLOYMENT

By the year 2000, these changes will result in decreases of 28 percent in Airway Facilities personnel requirements and 40 percent in Air Traffic personnel requirements from the 1981 levels. Estimates of Air Traffic employment in the year 2000 are based upon new studies which indicate that 70 percent of the demand for FSS services will be accommodated by the automated systems. Previous years' estimates were based on automated systems accommodating 90 percent of demand.



AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT
(FLIGHT SERVICE STATIONS)

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SUMMARY OF FACILITY CHANGES

1981 - Airway Facilities and Air Traffic employment for 979 facilities required a total of 5,487 people.

1985 - Air Traffic employment decreased to 4,553 due to the interim voice response system and the consolidation of manual flight service stations into automated stations. Airway Facilities staffing has decreased due to these consolidations and the conversion to solid-state equipment.

1990 - Airway Facilities employment will decrease due to facility consolidation and replacement of tone control equipment.

2000 - Decreases in Air Traffic staffing will occur due to the widespread acceptance of automated flight services. Despite the expansion of weather systems there will be a small decrease in Airway Facilities staffing. A total field work force of 3,370 will be required to operate and support FSS/weather facilities.

Outyear estimates are reviewed annually and are subject to revision.

FLIGHT SERVICE SYSTEMS AIR TRAFFIC/AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS

	1981	1985	1990	2000
Operations (Millions)	62.6	52.9	49.3	56.3
Air Traffic Personnel	4,671	4,553	4,250	2,780
AT Productivity Quotient	13,402	11,619	11,600	20,252
Airway Facilities Personnel	816	625	603	590
AF Productivity Quotient	76,716	84,640	81,758	95,424
Total AT & AF Staffing	5,487	5,178	4,853	3,370
Air Traffic Personnel Costs (thousands)	$127,051	$123,842	$115,600	$75,616
Airway Facilities Personnel Costs (thousands)	$27,826	$21,313	$20,562	$20,119

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PROGRAM RELATIONSHIPS

The current National Airspace System is limited in its ability to support the provision of flight services and rapidly acquire, process, and disseminate accurate weather data and operationally significant information to both flight service and air traffic control system users. The projects in this chapter provide the foundation for evolutionary improvements. These areas are grouped into four basic improvement categories: automation, mass weather dissemination, surveillance, and communications. In combination with initiatives contained in other chapters, (processing improvements obtained through AAS and TMS, data acquisition improvements obtained through the ASR 9 weather channel, NEXRAD, and data dissemination improvements obtained through NADIN and Mode S data link) they form the architecture required to reduce the risk of weather-related accidents and reduce the costs associated with weather-related delays.

Automation improvements provide information processing capabilities which increase system safety and FAA operational productivity, in keeping with the demand for timely and accurate weather information and service. System improvements include: the capability to meet the projected increases in demand for flight services without a proportional increase in staff and operational costs, the enhancement of real-time processing of hazardous weather data for air traffic control, the simplification of the storage and forwarding of data from sources to users, the upgrade in NOTAM processing and distribution, and the establishment of data link access to computer-based weather information from various sources.

Mass weather dissemination enhancements in this chapter provide near-term improvements in the availability and efficiency of on-the-ground (IVRS) and in-the-air routine (EFAS) and hazardous (HIWAS) meteorological and other information. These supplement the flight service station and air traffic control system capabilities, such as ATIS, which are described in other chapters. The implementation of an improved communications channel, such as EFAS, through the addition of new frequencies, also reduces frequency congestion problems. Techniques which allow for direct access to weather data increase the air traffic controller's and the flight service station specialist's productivity by freeing them from routine labor-intensive tasks. The near-term improvements provided by projects in this chapter may be viewed as evolutionary steps toward the programwide objective of a more timely and less labor-intensive system.

The surveillance improvement projects included in this chapter provide for the detection and display of more accurate, reliable, and complete meteorological information critical to FAA controllers, flight service specialists, and aviation users. In combination with the longer-term projects described in other chapters; e.g., NEXRAD, they will reduce the adverse impact of weather phenomenon by providing timely warning of such hazardous weather conditions as thunderstorms, turbulence, and wind shear.

Communications improvement focuses on the establishment of an economical integrated communications switching system which will ensure affordable ground-to-ground voice communications for the network of flight service stations and the terminal portion of the air traffic control system. This improvement, combined with improvements in other chapters, e.g., VSCS for en route air traffic control and all projects in Chapter 5, Interfacility Communications, is an evolutionary step toward the programmatic objective of controlled leased services costs.

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PROJECTS	IMPLEMENTATION	
	FIRST	LAST
AUTOMATION		
1. Flight Service Automation System (FSAS)	1986	1994
2. Central Weather Processor (CWP)	1994	1995
3. Consolidated NOTAM System (CNS)	PROJECT	COMPLETE
4. Weather Message Switching Center (WMSC) Replacement	1992	1992
5. Weather Communications Processor (WCP)/Data Link	1990	1992
MASS WEATHER DISSEMINATION		
6. Interim Voice Response System (IVRS)	PROJECT	COMPLETE
7. High-Altitude En Route Flight Advisory Service (EFAS) Frequencies	1987	1989
8. Hazardous In-Flight Weather Advisory Service (HIWAS)*	1988	1988
SURVEILLANCE		
9. Automated Weather Observing System (AWOS)	1989	1994
10. Radar Remote Weather Display System (RRWDS)	PROJECT	COMPLETE
11. Geostationary Operational Environmental Satellite (GOES) Recorders	PROJECT	COMPLETE
12. Low Level Wind Shear Alert System (LLWAS)	1985	1992
COMMUNICATIONS		
13. Integrated Communications Switching System (ICSS)	1983	1992

* Depot Delivery Dates

PROJECT SUMMARY

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PROJECT 1: Flight Service Automation System (FSAS)

Purpose: This project will improve user access to weather information and NOTAMs, simplify flight plan filing, and provide a flight service station automation system that will meet the projected increases in demand for flight services without proportional increases in staff.

Approach: Development and implementation of automation for Flight Service Stations will be phased.

Model 1 hardware has been procured and hardware integration testing has been successfully completed. Model 1 software design, build, and test are also complete. The first Model 1 system was commissioned in February 1986. Eleven more Model 1 systems were commissioned in 1986, and the last Model 1 will be commissioned in early 1988.

The Full Capacity Model 1 will build upon the base provided by the Model 1 design. This system will provide additional hardware (including Aviation Weather Processors) and the necessary software to increase processing capacity to allow completion of FSS consolidation. During Full Capacity Model 1 implementation, all Model 1 systems will be converted to Full Capacity Model 1 systems. In addition, Full Capacity Model 1 systems will be provided to the remainder of the AFSS and FSDPS facilities.

The capability for direct user access terminals to improve user access to weather information and flight plan filing, and the capability for stand alone specialist weather graphics will be leased or purchased from commercial vendors to meet a schedule compatible with systems installations.

Through 1988, thirty-seven automated flight service stations will be commissioned. All 61 automated flight service stations will be commissioned by 1994.

Products:

- Model 1.
  - 13 flight service data processing systems (at ARTCCs).
  - 37 FSSs equipped with automation position equipment.
- Model 1 Full Capacity.
  - 2 aviation weather processors (at NADIN switching centers).
  - 23 operational flight service data processing systems.
  - 61 automated flight service stations.

Related Projects/Activities: Flight service facilities space for most of the 61 automated flight service stations will be acquired on a sponsor-provided leased basis at selected airports. The 61 new facilities will house FSAS specialist automation positions and the other equipment necessary to satisfy FSS system requirements. The ICSS, AAS, DF modernization, WMSCR, TMS, and CNS will support enhanced flight services. GOES will provide satellite weather information for pilot briefings. This program will require interfacility communications service from NICS, including Data Multiplexing which will consolidate the data for transmission, and NADIN. The FSAS will interface with RMMS.

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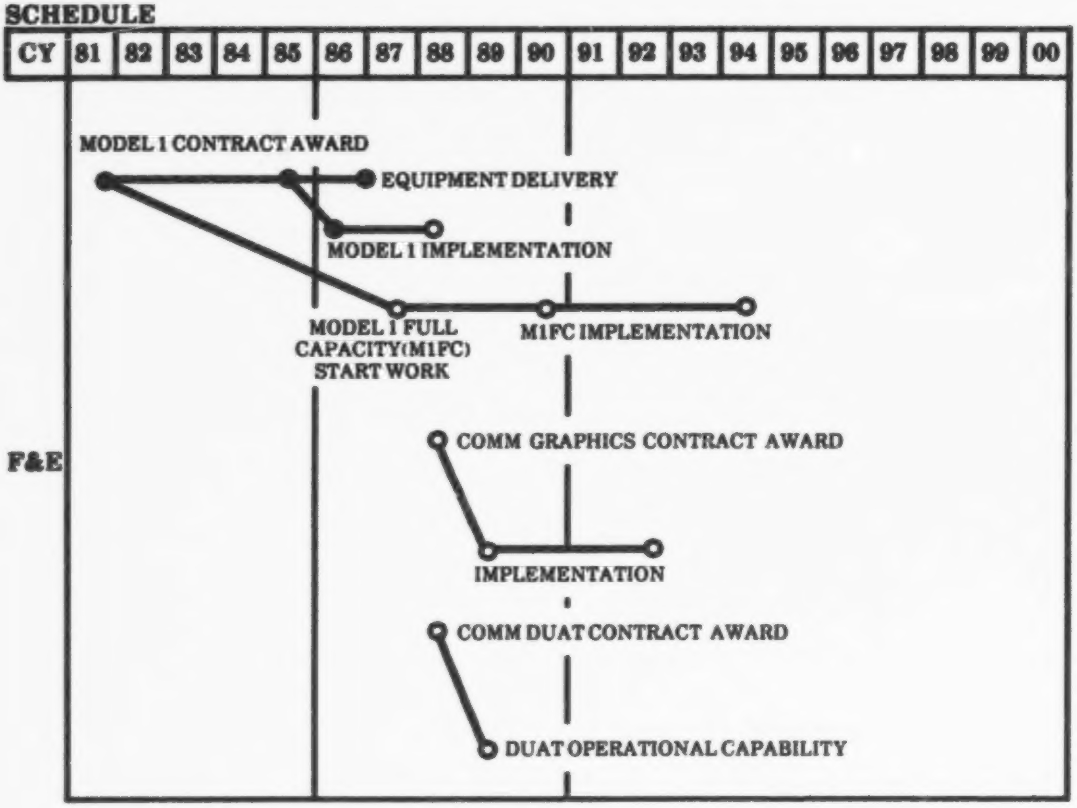
SCHEDULE



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PROJECT 2: Central Weather Processor (CWP)

Purpose: This project will improve the collection, synthesis, and dissemination of weather information throughout the National Airspace System to pilots, controllers, flight service station specialists, traffic management specialists, and meteorologists. This project provides the CWSU/CFWSU meteorologists with automated work stations which greatly enhance their ability to analyze rapidly changing, potentially hazardous weather conditions, and ensures that the latest and best information is provided to all system users. It also provides for a mosaic display of multiple radars. These improvements are deemed necessary to reduce the high percentage of accidents and air traffic delays directly related to weather.

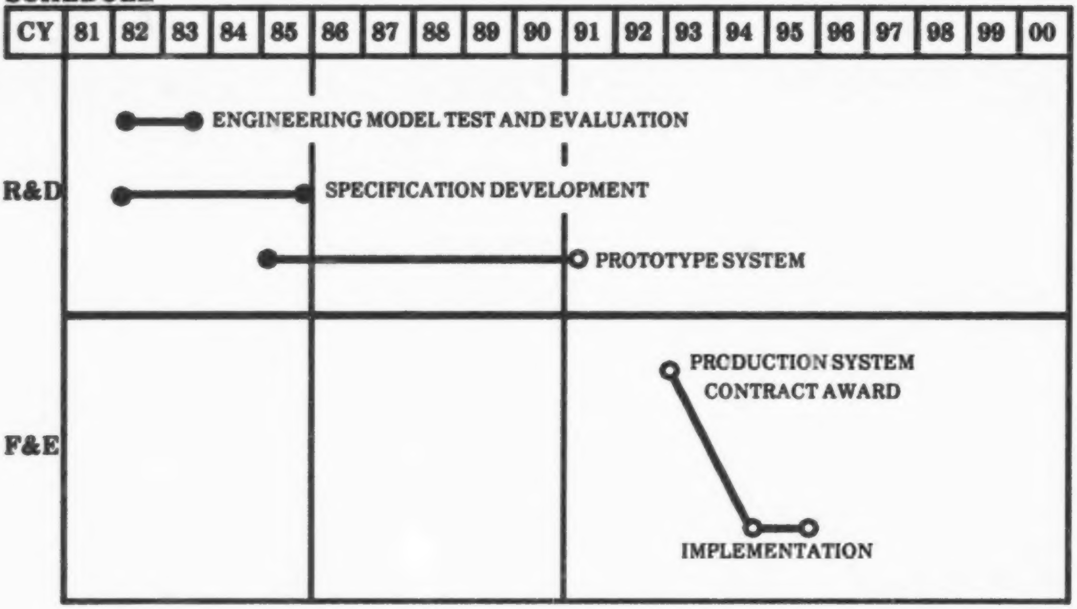
Approach: A contractor will develop operational software on a prototype hardware system. The system will undergo operational test and evaluation at the FAA Technical Center. After approval for production, production hardware systems will be procured. Software developed during the prototype phase will be government-furnished to the production contractor for field implementation.

Products: F&E – 26 production systems, including documentation and logistics support (23 to ACFs, a central flow weather processor (CFWP) version to the Central Flow Control Facility, 1 to the FAA Academy, and 1 to the FAA Technical Center).

Related Projects/Activities:

- GOES – The CWP will receive weather satellite images from the GOES satellite.
- NEXRAD – The CWP will receive periodic products and request/reply products from NEXRAD.
- WMSC replacement – The CWP will receive NWS and other alphanumeric and graphic data and PIREPs from the WMSC replacement. The CWP will also send PIREPs and CWSU products to the WMSC replacement.
- AAS – The CWP will send weather products to and receive PIREPs from the AAS.
- ADAS – The CWP will receive AWOS/ASOS data via the ADAS.
- RMMS – The CWP will interface with the maintenance processing subsystem (MPS) for status reporting.
- TMS – The CFWP will provide automated workstations for the CFWSU meteorologists who support the traffic management specialists in the CFCF.
- This project will require interfacility communications service from NICS. Projects providing that service include NADIN.

SCHEDULE



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PROJECT 4: Weather Message Switching Center (WMSC) Replacement

Purpose: This project will replace the weather message switching center (WMSC) with state-of-the-art equipment and technology to perform all current alphanumeric weather data handling functions of the WMSC, and the storage and distribution of NOTAMs. It will rely on NADIN for a majority of communications support. Further, the system will also accommodate graphic data and function as the sole FAA gateway to the National Meteorological Center (NMC) and, therefore, will be the source of National Weather Service products for the NAS.

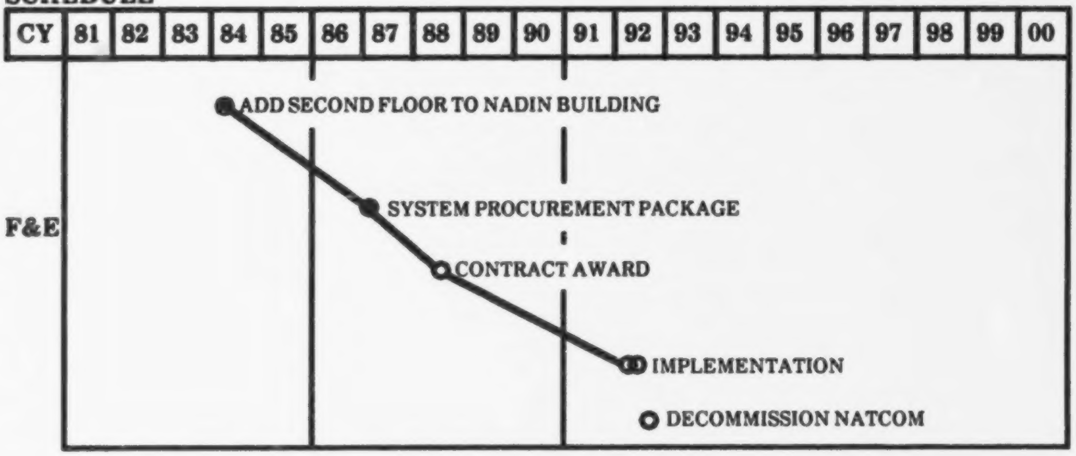
Approach: The system will be procured for turnkey installation. To provide geographic redundancy, the WMSC replacement will have nodes located in the National Aviation Weather Processor (NAWP) facilities (Atlanta, GA, and Salt Lake City, UT, NADIN buildings). Each node will support approximately one-half of the United States and continuously exchange information with the other to ensure that both nodes have identical national data bases. In event of a nodal failure, the surviving node will assume responsibility for the entire network. The implementation of the WMSC replacement will allow the closing of the National Communications Center (NATCOM). Upon closing, the NATCOM building will be refurbished for GSA.

Products: WMSC replacement processors and related peripherals to be located at each of the two NAWP facilities.

Related Projects/Activities:

- FSAS – The WMSC replacement will transmit and receive alphanumeric weather data and NOTAMs from the Aviation Weather Processor (AWP).
- CWP – The WMSC replacement will transmit alphanumeric and graphic weather products from the NMC to the CWP, and will receive alphanumeric products from the CWP.
- ADAS – The WMSC replacement will route weather products from the ADAS to the NMC, and other NAS users.
- WCP – The WMSC replacement will transmit alphanumeric weather data to the Weather Communications Processor (WCP).
- CNS – The WMSCR will store and distribute NOTAMs from CNS.
- NADIN – The WMSC replacement will interface with the NADIN Packet Switch Network (PSN) which will provide the communications between the WMSC replacement and its users.
- RMMS – The WMSC replacement will interface with the maintenance processor subsystem for status reporting.

SCHEDULE



PROJECT 5: Weather Communications Processor (WCP) /Data Link

Purpose: This project will develop and implement data link services utilizing the discretely addressed data link capability inherent in Mode S. The WCP will serve as the initial communication/service processor for weather information for the Mode S data link. It will receive downlink requests for weather products from Mode S sensors, decode those requests, format the replies, and return them to the pilot via the Mode S data link. This will improve air-ground communications services by expanding the ability of the pilots to access desired information, and reduce the workload of specialists and controllers who currently represent the only means of such access.

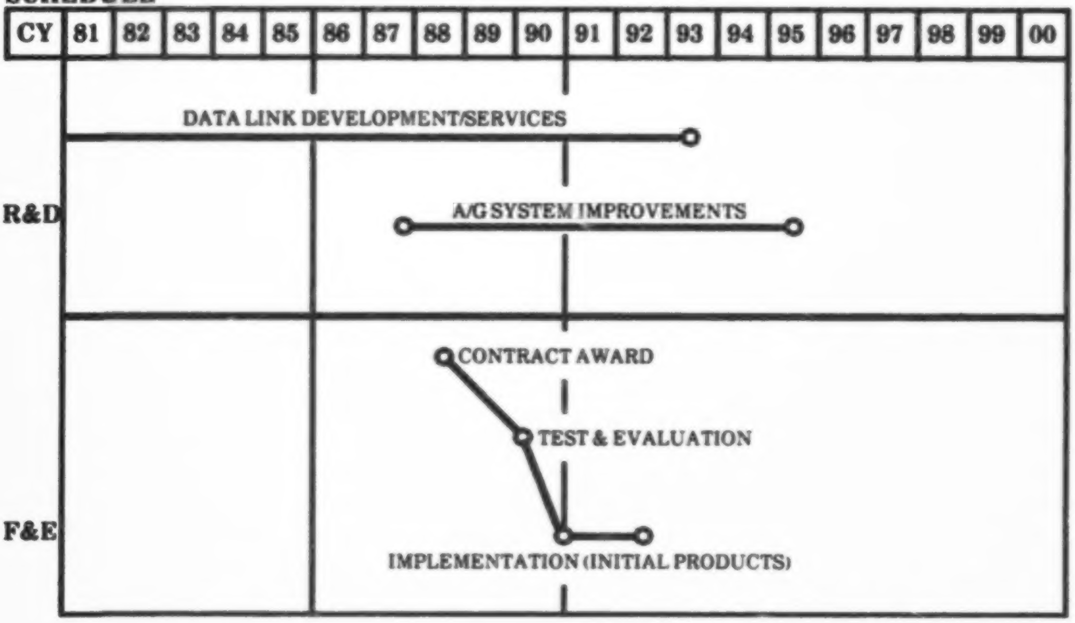
Approach: Initially, data link services will be implemented using the WCP. Services will be those for which automated data bases currently exist, or are planned to be operational in the near term. These include alphanumeric products such as SIGMET, AIRMET, surface observations, terminal forecasts, winds aloft, pilot reports and radar summary information. Data link communications protocols and message coding standards will be developed to support the services and assure consistent presentation of information to the pilot. These early products will be tested to determine user acceptability and aid in the process of fully defining the longer-term data link requirements.

Products: 24 WCPs - 22 to future ACFs, 1 to the FAA Academy, and 1 to the FAA Technical Center.

Related Projects/Activities:

- Mode S – The WCP will interface with the Mode S to receive requests for weather products and route responses for transmission.
- AAS - The AAS will provide data link processing for ATC functions.
- WMSC/WMSCR – The WCP will obtain alphanumeric products from the WMSC/WMSCR to respond to pilot requests.
- ADAS – The ADAS will send minute-by-minute AWOS/ASOS messages to the WCP for storage and dissemination via the Mode S data link.
- RMMS – The WCP will interface with the maintenance processor subsystem (MPS) for status reporting.
- This project will require interfacility communications service from NICS. Projects providing that service include RML Replacement and Expansion which will provide the communications network for transmission of data.

SCHEDULE



PROJECT 7: High-Altitude En Route Flight Advisory Service (EFAS) Frequencies

Purpose: This project will provide a clear communications channel at 18,000 feet and above for the collection and dissemination of pilot reports (PIREP) and en route weather information.

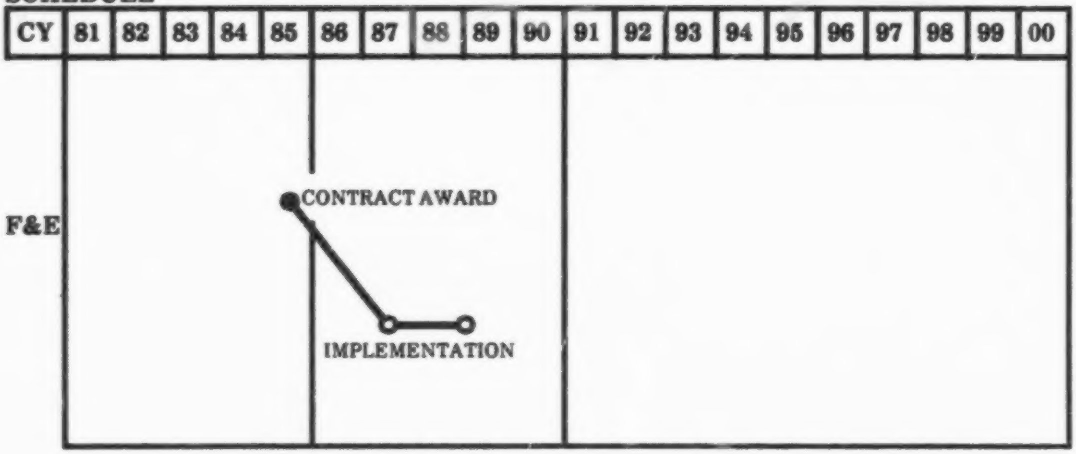
Approach: Based on the Nationwide Frequency Allocation Study, establish frequencies in addition to present en route flight advisory service (EFAS) at 122.0 MHz. Discrete frequencies have been assigned for each ARTCC area. The new frequencies would be protected from adjacent flight watch control station frequencies to reduce frequency overlap problems. Implementation for 20 FSS EFAS or AFSS EFAS facilities will use approximately 60 communications outlets selected in accordance with plans for air-ground communications facility consolidation.

Products: Approximately 60 communications outlets controlled from FSS EFAS locations will be established.

Related Projects/Activities:

- Frequency and spectrum engineering will ensure that EFAS frequencies are free of interference.
- Site locations for EFAS equipment have been chosen in conjunction with communications facility consolidations.
- Hardware supporting this project have been procured in conjunction with Air/Ground Communications Modernization.
- FSAS – As FSS consolidation proceeds, service will be provided from 20 AFSSs.

SCHEDULE



PROJECT 8: Hazardous In-Flight Weather Advisory Service (HIWAS)

Purpose: This project will provide continuous prerecorded broadcasts of weather advisories over selected VORs. Weather advisories include: significant meteorological information (SIGMET), convective SIGMETs, airmen's meteorological information (AIRMET), and significant PIREPs. HIWAS broadcasts will relieve air traffic controllers and flight service specialists from the labor-intensive task of broadcasting these weather advisories and improve the timeliness of dissemination.

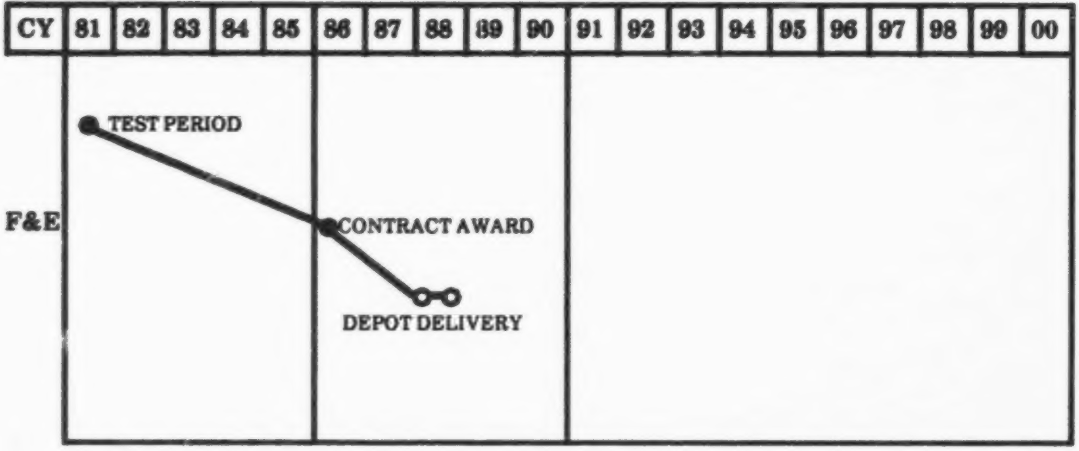
Approach: A test was conducted in the Southern Region using 13 VOR locations in the Miami and Jacksonville ARTCC areas. Nationwide implementation will begin in 1988 using sufficient VORs to provide communications coverage at and above 4,000 feet agl.

HIWAS will replace the 3-minute single-tape transcribed weather broadcast service now being provided by selected FSSs. The HIWAS VOR outlets will be selected to avoid competition for VOR voice features that are required for AWOS. The HIWAS recordings will be prepared manually by FSS specialists using solid-state recorders allowing 4-minute capacity. Manually prepared HIWAS will begin to disappear when the FSAS equipment can generate a computer voice product to provide an equal or better service. Due to equipment similarities, the HIWAS and ATIS recorders are being procured under the same contract.

Products: Recording equipment will be provided at a number of FSS locations to provide continuous broadcasts over selected VORs. It is estimated that at least seven FSSs in each ARTCC area will prepare HIWAS broadcasts. The number of FSSs with HIWAS responsibility will decrease with the consolidation of FSSs.

Related Projects/Activities: FSAS – The manually prepared HIWAS will gradually be replaced by automated broadcasts available from FSAS. FSS consolidation will reduce the number of FSSs supplying manual HIWAS broadcasts. Frequency and spectrum engineering will protect frequency allocation. This project will require interfacility communications service from NICS.

SCHEDULE



PROJECT 9: Automated Weather Observing System (AWOS)

Purpose: AWOS will obtain aviation critical weather data (e.g., wind velocity, temperature, dew point, barometric pressure, cloud height, visibility, precipitation type, occurrence and accumulation) through the use of automated sensors; process the data; and allow the dissemination of this information to pilots via computer generated voice.

Systems located within an ACF's area of responsibility will be connected to the AWOS Data Acquisition System (ADAS) in the ACF. The ADAS will primarily function as a message concentrator collecting weather messages from the AWOSs and National Weather Service ASOSs for internal distribution within the ACF and national distribution via WMSCR to NWS. This will permit weather observation data to be made available to pilots on a timely basis for safety and efficiency. Additionally, timely observations are essential to improve forecasting.

Approach:

A demonstration program for AWOS was successfully completed in July 1984. During that time the FAA requirements for production AWOS systems were specified. Immediately thereafter, a Pilot Program contract was awarded for a design of an AWOS meeting all FAA requirements for nontowered airports.

The acquisition of production AWOS equipment will be accomplished through a joint national procurement with the National Weather Service. Under this procurement NWS will procure, install, and maintain automated observation equipment at all selected airports. Implementation of these systems by NWS for nontowered airports will begin in early 1991 and be completed in 1992. Post 1992 requirements for 304 towered airports and FSS locations where the FAA currently takes surface observations will also be met by the NWS supplier.

An advisory circular (AC 150/5220-16) was published for type certification and acquisition of affordable AWOS devices by airport operators, fixed base operators, heliport operators, etc., for their needs. This document is the basis for systems to be approved under AIP funding.

FAA requirements prior to the NWS program deliveries will be met in the interim through an acquisition of commercial off-the-shelf equipment meeting the requirements of the advisory circular. These interim systems will be replaced, as required, from NWS system deliveries.

Products:

- 233 nontowered airports (F&E funded, NWS contract). Options to include an additional 204 systems.
- 304 towered airports (F&E funded - Post 1992, NWS contract).
- 160 nontowered interim systems (F&E funded, FAA contract).
- 400 nontowered airports (AIP funded). (Estimated).
- 4 heliports (demonstration).
- 25 ADASs - 23 to ACFs; 1 FAA Academy; 1 FAATC.

Related Projects/Activities:

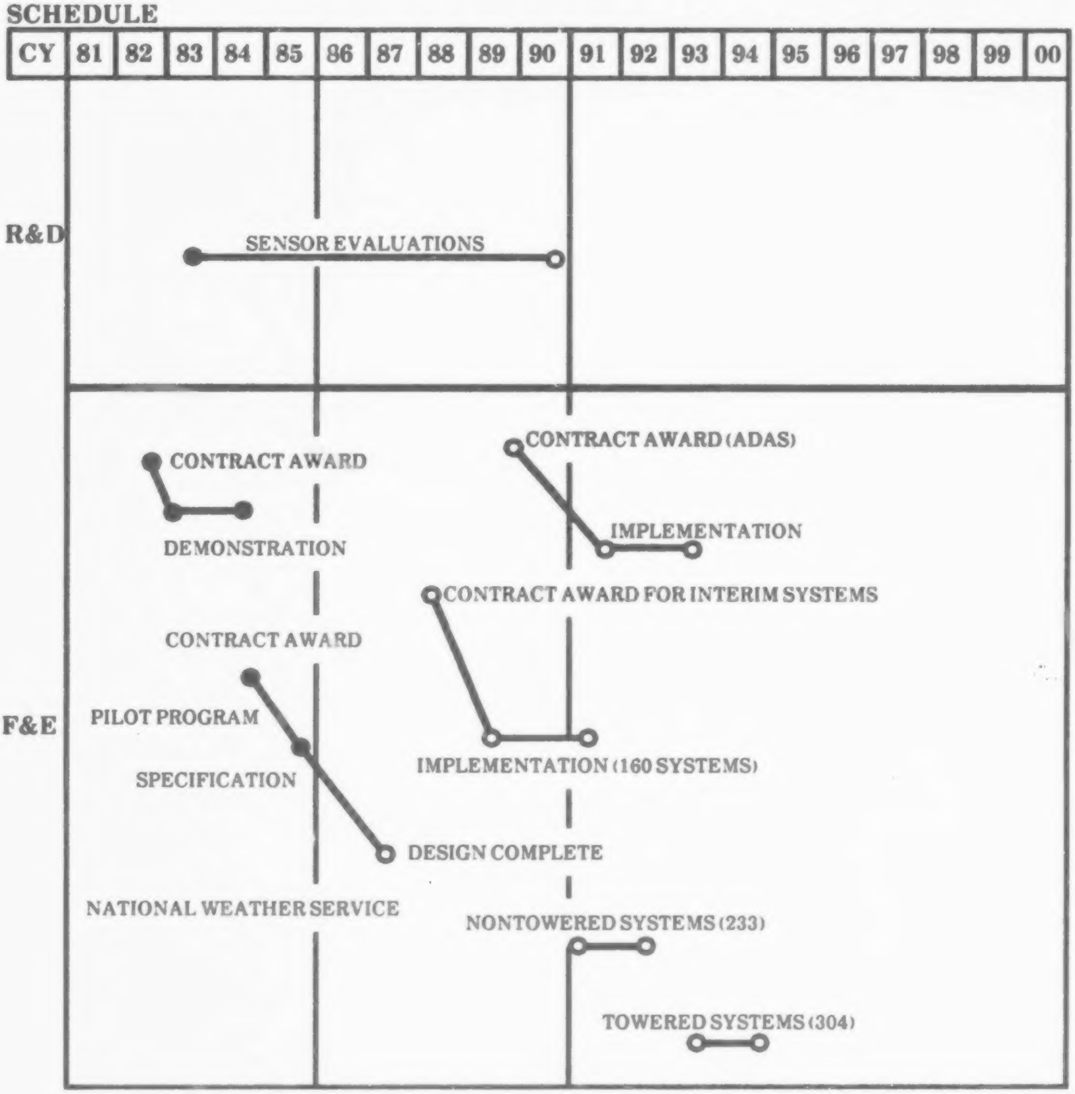
- VOR/NDB network and consolidated communication facility implementation – AWOS data will be broadcast through VOR/NDB or discrete VHF/UHF communications outlets depending on cost-effectiveness and spectrum engineering.
- ATIS – AWOS generated data will be furnished for controller's use and update of ATIS weather information if required.
- Rotorcraft program – AWOS will support the surface weather observation needs of FAA's rotorcraft programs as well as short-term forecasting.
- NAS spectrum engineering will provide interference-free frequencies for broadcasting AWOS information.
- NWS – The ADAS will translate AWOS weather messages into the standard Aviation Weather Observation format and send them to NWS.

- This project will require interfacility communications service from NICS. Projects providing that service include RML Replacement and Expansion, which will provide the transmission network for AWOS data and Data Multiplexing which will consolidate the data for transmission.

- WCP – ADAS will provide minute by minute AWOS and ASOS data to WCP to respond to pilot requests via Mode S data link.

- WMSCR – The WMSCR will receive AWOS hourly and special weather messages through the ADAS.

- CWP – The CWP will receive the current (minute by minute) AWOS and ASOS weather messages from the ADAS for processing.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IMPLEMENTATION (160 SYSTEMS)
DESIGN COMPLETE
NATIONAL WEATHER SERVICE
NONTOWERED SYSTEMS (233)
TOWERED SYSTEMS (304)

PROJECT 12: Low Level Wind Shear Alert System (LLWAS)

Purpose: This project will provide pilots with information on hazardous wind conditions (on or near airports) that create unsafe conditions for aircraft landings or departures.

Approach: The FAA continues to seek solutions to problems associated with hazardous winds and their effect on aircraft. Efforts are divided into two categories--ongoing implementation programs for proven sensors and programs requiring continued research and development for improved sensors and predictors. Wind shear detection equipment is being implemented through an ongoing program for the low level wind shear alert system (LLWAS). Since LLWAS is not the complete answer for detecting all wind shears, two avenues are being explored -- enhancement of the LLWAS as new scientific information becomes available and continued research and development of Doppler radar to identify hazardous conditions.

- LLWAS. This is an ongoing program which, when completed, will provide 110 systems. There are ninety 6 sensor systems presently in operation. Seventeen additional 6 sensor systems will be commissioned as land is acquired for the installation of the wind sensors on the tall poles. The remaining 3 systems will be installed as part of the 6 sensor improvement program. The 6 sensor system consists of wind sensors located at center field, five sensors near the periphery of airports, and a computer which processes sensor information and displays wind shear conditions to air traffic controllers for relay to pilots. Two enhanced operational LLWAS test beds consisting of one center field and ten/eleven remote units instead of one center field and five remote units were installed in New Orleans/Denver. All the data are being recorded and analyzed to determine the benefits of increasing the number of sensors. Using data from JAWS (Joint Airport Weather Studies), a computer simulation model has been developed to permit evaluation of different algorithms and optimizing the number of sensors. The results of this evaluation and the analysis of the data collected from the operational test beds at New Orleans and Denver will be used to configure the modifications needed to permit LLWAS to detect shears caused by both fronts and microbursts.

  Both near-term and long-term modifications are planned for the LLWAS system. Near-term modifications consist of improving the algorithms associated with the 6 sensor system to more effectively detect and identify microbursts, correcting sensor height to reduce sheltering, incorporating data recorders, and increasing the computer capacity. Long-term modifications include: expanding the existing systems by adding 5 more sensors, developing improved algorithms for the 11 sensor system, and designing new information/alert displays. These improvements, in addition to increasing LLWASs capability to detect wind shear, will also reduce false alarms and enhance maintenance features. R&D activities include evaluation of new sensors to reduce icing impact and siting construction.

- JAWS. This joint effort among FAA, National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), etc., utilized an array of Doppler radars, automated surface observations, radiosondes, lightning detection systems, and instrumented aircraft to detect and analyze weather hazards to aircraft. This data was gathered during 1982 at Denver, Colorado. Hazards included wind shear, downbursts, microbursts, heavy rain, and thunderstorm-associated weather. Analysis of the data has provided information for inclusion in the enhanced LLWAS, NEXRAD, and TDWR specifications. Data are being used to assist in reassessing LLWAS siting criteria.

Products:

- Wind shear models have been developed and a report published in 1985.
- Additional 6 sensor LLWASs will be installed by 1987.
- The final report on JAWS will be available in 1987.
- 6 sensor LLWAS improvements at 110 sites.
- Expansion of the 6 sensor LLWAS to an 11 sensor system with improved display at 110 sites.

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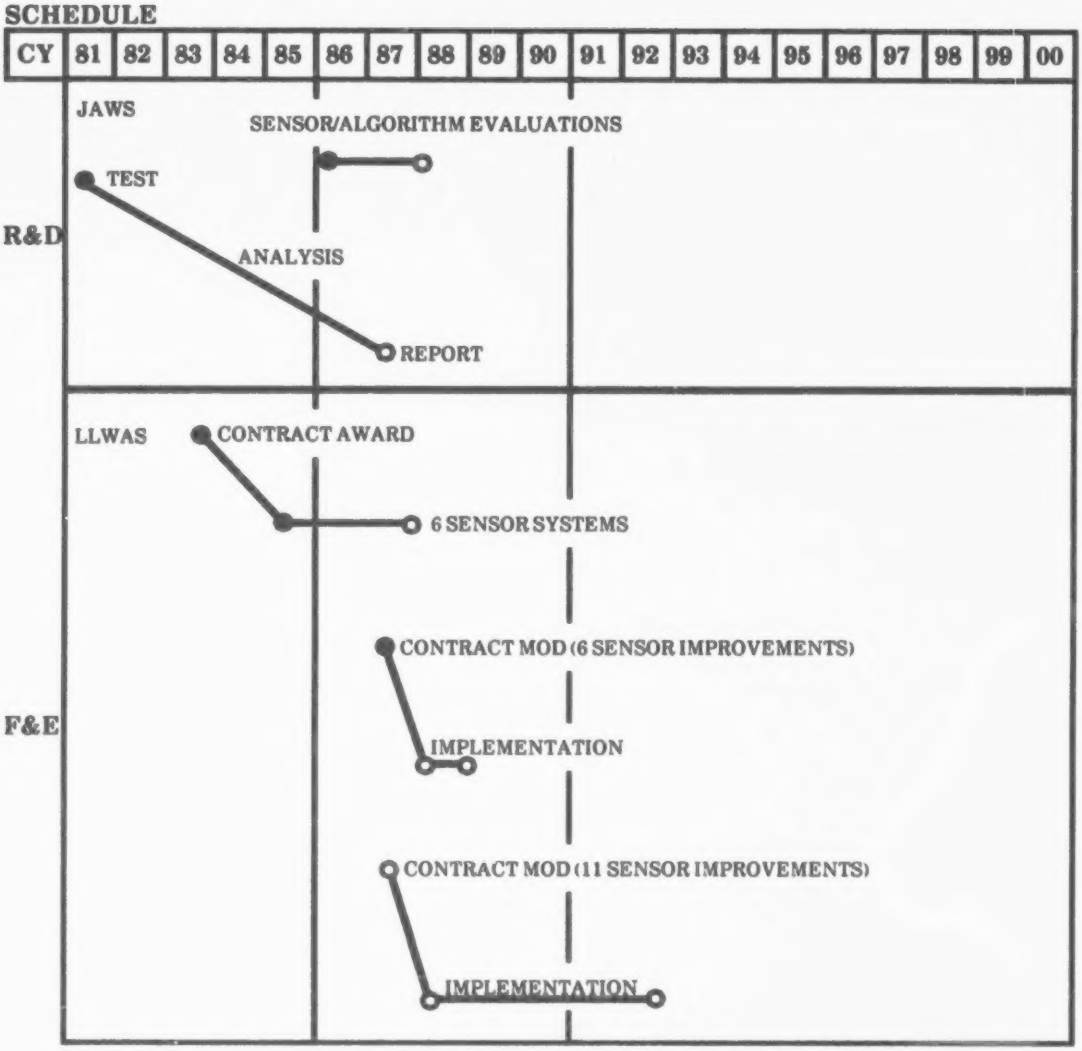
Related Projects/Activities:

- NEXRAD and TDWR – The results of JAWS development efforts will be factored into the production specifications for these systems.
- AAS – In ATCTs, the tower control computer complex (TCCC) will receive and display LLWAS data to the ATCT controller.
- NAS frequency and spectrum engineering will ensure the LLWAS frequencies are free of interference.

SCHEDULE



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PROJECT 13: Integrated Communications Switching System (ICSS)

Purpose: This project will provide voice communications switching systems for new, replaced, or modernized ATCTs and TRACONs (previously provided with leased TELCO equipment), and for facilities which have obsolete equipment which can no longer be maintained. Also, it will provide systems for use at 61 automated FSSs.

Approach: An initial procurement and one reprocurement phase are envisioned to implement ICSS. In the first phase, competitive proposals were solicited for off-the-shelf systems, dividing the requirement into three types with increasing technical capabilities:

- Type 1 for ATCTs and TRACONs having up to 15 operator positions. Basic intercom, interphone, and radio communications capabilities were specified as an integrated system.

- Type 2 for TRACONs having 16-80 operator positions. All Type 1 requirements plus rapid automatic reconfiguration of pushbutton terminations, alphanumeric displays of the button functions, and traffic data collection were specified.

- Type 3 for automated FSSs. Type 2 requirements plus an automatic call distributor, call transfer, pilots automatic telephone weather answering service (PATWAS), fast file recorders, and a management information system display were specified. These systems will continue in use at all automated FSS facilities.

First-phase contracts for all three types were awarded in May 1982. Type 1 systems are being obtained from one contractor. Type 2 systems are being obtained from another contractor. Both contractors are to supply Type 3 systems.

The reprocurement contract award for Phase IA is projected for 1988. Under this phase, the remainder of Type 3 ICSSs for AFSSs will be procured.

Under each of the phases, systems are being leased with an option to buy. If purchase is advantageous and funds are available, the option will be exercised on a system-by-system basis.

Products:

- Phase I:
  - 132 Type 1 systems for small ATCT/TRACONs.
  - 31 Type 2 systems for larger TRACONs.
  - 45 Type 3 systems for AFSSs.
- Phase IA:
  - 16 Type 3 systems (plus 3 support systems, 1 for FAATC, 2 for Aeronautical Center)

Related Projects/Activities:

- ATCT/TRACON Replacement and Modernization – ICSS will be installed as voice communications switching system for new, replaced, or modernized ATCTs and TRACONs.

- FSAS – ICSS is the communications equipment of the AFSS facility that will enable the AFSS to establish voice communications with pilots and other operational personnel throughout the ATC system.

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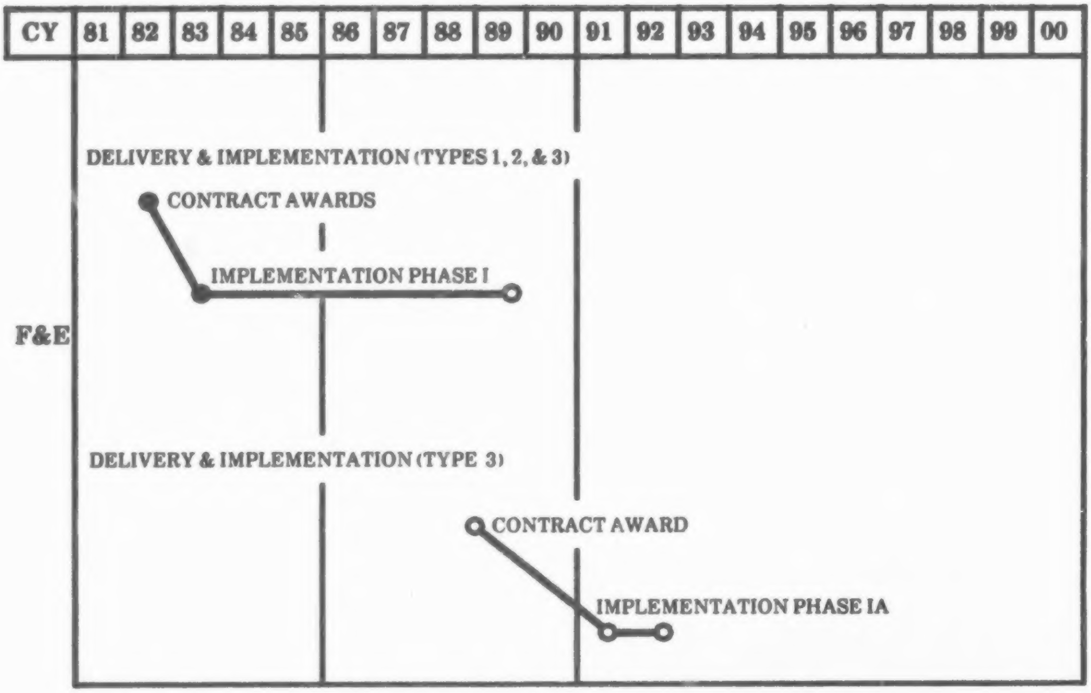
SCHEDULE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DELIVERY & IMPLEMENTATION (TYPE 3)
CONTRACT AWARD
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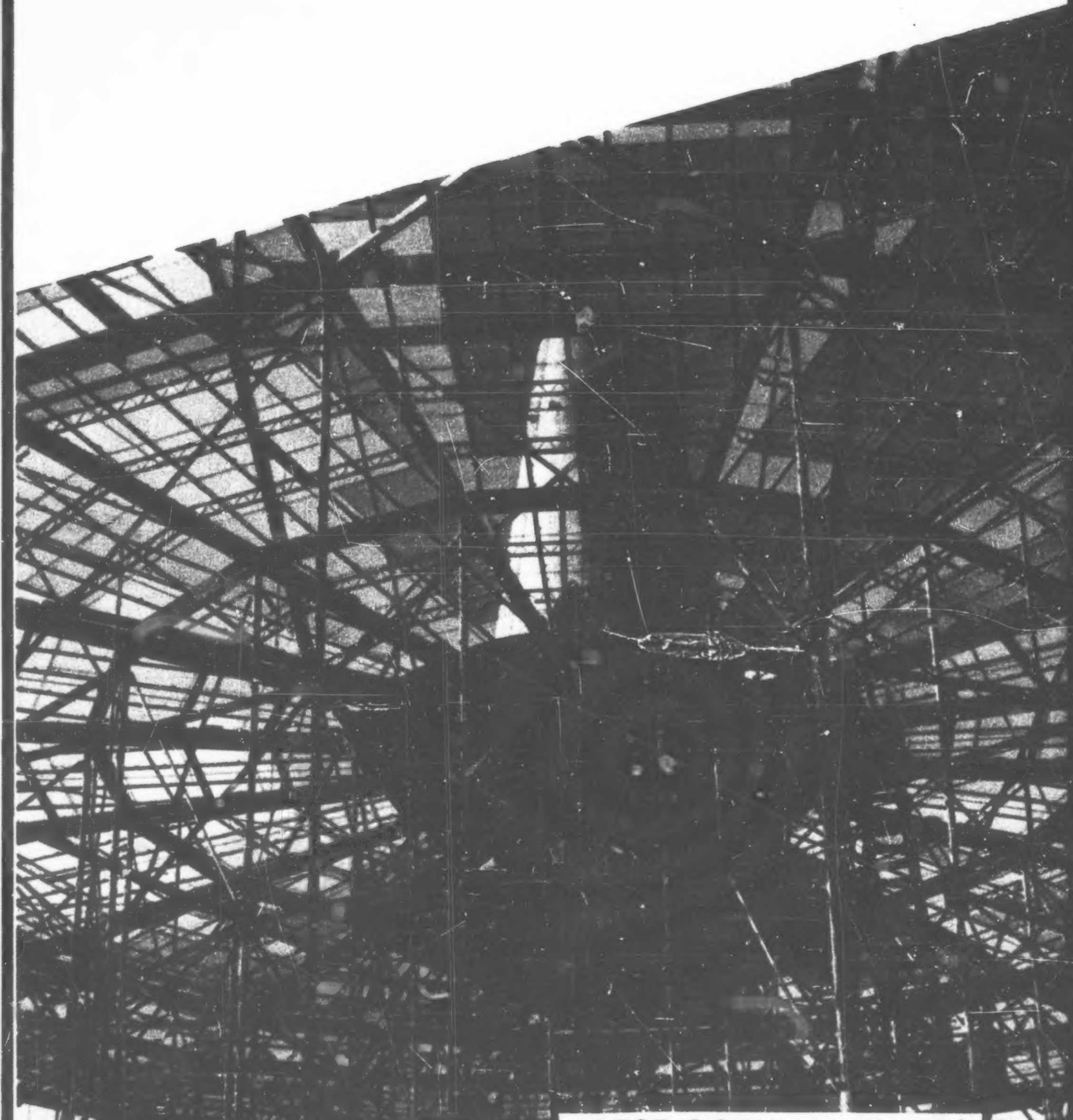
CHAPTER IV

GROUND-TO-AIR SYSTEMS



GROUND-TO-AIR SYSTEMS

The ground-to-air systems provide visual and electronic interfaces to aircraft which allow them to communicate with the ground, navigate, approach, land safely, and operate under air traffic control surveillance. The navigational systems are generally used en route between airports and remotely located from the using air traffic control facilities; e.g., ARTCCs, ATCTs, TRACONs, and FSSs. Approach and landing equipment is located at airports. The communication and surveillance equipment is located both at airports and remotely, as required, for en route operations.

Parts of the current electronic systems are old, vacuum-tube devices. Other parts of the systems are more recent solid-state construction. The newest equipment is solid-state with remote monitoring capability.

COMMUNICATIONS

Ground-to-air communications facilities allow voice radio communications between air traffic control facilities and aircraft through the use of radio. Separate facilities are provided for communication between controllers and pilots in en route and terminal airspace. Other ground-to-air facilities provide communication between aircraft and flight service station specialists who advise pilots or are advised by pilots regarding their flight plans, weather, and other en route advisories.

The air route traffic control centers communicate with aircraft using remote center air/ground (RCAG) communications stations located to provide coverage for each en route air traffic control sector. The modernization of these facilities to replace vacuum-tube transmitter receiver equipment is complete. However, the present signaling and control equipment is obsolete, making it costly to maintain. The terminal area facilities use remote transmitter/receiver (RTR) stations for ground-to-air communications. The majority of them are still vacuum tube-type, and their signaling and control equipment is obsolete. The ground-to-air communication equipment at flight service stations is also obsolete since few of them are solid state.

NAVIGATION

The principal civil navigation system is the VHF omnidirectional range (VOR), a radio device that provides azimuth guidance to pilots of suitably equipped aircraft. Distance information is provided from the distance measuring equipment (DME). Military aircraft use the UHF tactical air navigation (TACAN) system for both azimuth and distance guidance. VOR, DME, and VOR/TACAN have been located to provide optimum guidance in those areas that are heavily traveled. Airways are comprised of line segments between these navigational facilities.

The nondirectional beacon is a lower-cost, lower-capability alternative of the VOR station and is used where the air traffic demand for an air route is not great enough to justify the more expensive VOR. These beacons are used for en route guidance and fixes as well as being part of landing systems.

The implementation of the Department of Defense satellite-based global positioning system (GPS) will provide navigation coverage unavailable today and allow increased direct navigation on fuel-efficient paths. Until the GPS is in widespread use throughout the NAS, the LORAN C system can function as an interim, supplementary navigation system for those areas not fully covered by the airways.

The air route procedure is used to maintain a safe and controlled airspace using existing technology. Aircraft equipped for area navigation can fly direct efficient paths, but this application is limited due to the present air traffic control system's problems with handling aircraft outside the air route structure.

Some of the navigational aid equipment is obsolete, costly to maintain, and is being replaced with modern solid-state devices.

APPROACH AND LANDING AIDS

The present airport electronic approach and landing system is the instrument landing system (ILS). Precision approach ILS provides both azimuth and elevation guidance to a runway from a ground facility. Marker beacons, lighting systems, distance measuring equipment (DME), and compass locators are associated with ILS to enable equipped aircraft to fly along the approach path to the runway. Nonprecision approaches at many airports are also based on the use of VOR or NDB. Lighting systems are also used independently as visual approach and landing aids.

SURVEILLANCE

Surveillance of the airspace is currently provided by two types of radar -- search radar and beacon radar (sometimes known as primary and secondary radar). They are generally located at the same site. Search radar relies only on signals reflected from aircraft or from weather. The beacon system receives reply signals transmitted from airborne electronic equipment called transponders. On aircraft equipped with altitude encoders, the transponder automatically transmits the aircraft's altitude. The beacon system is presently the main source of surveillance information used for air traffic control. Search radar supplements beacon and gives weather information.

There are, additionally, two types of search radars. The en route air traffic control system relies principally on air route surveillance radar (ARSR)/long range radar (LRR), while the terminal air traffic control system uses shorter range airport surveillance radar (ASR). Both radars are used extensively for flight monitoring. Some existing radars are tube type and obsolete, while others are solid state. Because search radar was designed for aircraft surveillance, it is presently capable of giving only limited information on weather and precipitation. Another type of radar, airport surface detection equipment (ASDE), is used by tower controllers to detect aircraft and vehicles on runways and taxiways during low-visibility conditions.

The direction finder (DF) is used to locate lost aircraft and for other emergencies. The aircraft's bearing is determined on the ground by using radio transmissions from the aircraft. The guidance information is then transmitted to the aircraft on a voice channel. The majority of the present DF systems are tube type and are located at flight service stations.

THE NEW APPROACH

The major improvements of this chapter upgrade ground-to-air systems to solid state; provide for remote maintenance monitoring; and match the location of navigation, surveillance, approach and landing systems, and communications facilities with the projected demand. New and more capable systems such as the Mode S with data link, the microwave landing system (MLS), next generation weather radar (NEXRAD), and terminal doppler weather radar (TDWR) will also be placed into operation.

To develop a nationwide system of navigation, surveillance, and communications, as well as weather radar coverage, a networking concept will be used. Due to line-of-sight transmissions and the earth's curvature, systems provide coverage at lower altitudes the closer an aircraft is to a facility. Radar surveillance with Mode S or ATCRBS will be provided down to the ground at qualifying airports. Ultimately, as traffic growth requires, surveillance radar and Mode S coverage will be provided down to 6,000 feet altitude above mean sea level or the minimum en route instrument flight rule (IFR) altitude, whichever is higher. Weather radar coverage will be provided above 10,000 feet and down to the surface at selected airports. En route navigation and communication coverages will be available 2,000 feet above the terrain except where there is little air traffic. Direction finder coverage will be expanded as required, emphasizing those areas below radar coverage.

The ground-to-air communications system will be improved and modernized by replacing old, obsolete tube-type equipment with new solid-state equipment. Further improvement to operating cost will result from consolidation of as many facilities as practical. This will be done without loss of required service coverage. Communications and navigation networking studies will aid in identifying candidates for consolidation or relocation.

The navigation system will further be improved by replacement of maintenance-intensive equipment with solid-state systems and establishment of additional systems to provide coverage where it is required and not available today. In addition to VOR and DME equipment, which is the primary navigational system, the global positioning system (GPS) will gain popularity as a navigational system. This imposes rather stringent requirements upon the FAA to monitor the GPS satellites for accuracy and service availability. GPS monitors will provide the FAA with the data required to certify the system and maintain the appropriate margin of safety. LORAN C, with over 40,000 users already equipped, will be expanded to provide midcontinent coverage. LORAN C monitors will be installed to support nonprecision approaches by providing accuracy and availability information.

The approach and landing systems will be modernized. Obsolete equipment will be replaced and new systems established as dictated by operational requirements. New ILS components will be installed to replace tube-type components. The microwave landing system (MLS) will be installed to provide new and improved services and add capacity for approach and landing operations. Under current plans, MLS will replace ILS equipment at all locations. Runway visual range systems will provide accurate information for pilots preparing to execute IFR approaches. Additional visual navaids, including new types such as precision approach path indicators (PAPI), will be installed to enhance safety during visual approaches to airports. Approach lighting will provide lighting necessary for various categories of terminal operations.

Surveillance systems will undergo the most radical changes. The addition of Mode S will provide more accurate aircraft positioning information, allow for discrete aircraft identification, and provide the framework for data link services. New terminal radars will replace vacuum-tube systems that are difficult to maintain, and an expanded number of locations will have radar service. New airport surface detection equipment (ASDE) will replace the present systems; and new locations will be established, providing the ground surveillance capability required at our busiest airports. New ASDE will provide controllers with more accurate and reliable information than those radars presently installed and will greatly increase the safety of ground movement of aircraft.

Long-range radar, including those radars currently installed at joint-use locations, will be solid state. The joint use of military radars to supplement existing coverage will be expanded.

New weather radar will provide more reliable and accurate data to aid in forecasts and detection of real-time weather phenomenon.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Many ground-to-air systems improvements required through the initial period have been completed. The main focus has been the replacement of obsolete vacuum-tube equipment. The newer solid-state equipment has remote monitoring and control capability for more cost-effective systems maintenance.

The modernization of the voice communications system proceeded on schedule. The first phase of tube-type replacement (for en route air traffic control) is complete; the second phase (for terminal air traffic control) is underway; the third phase (for flight service stations) is under contract. Consolidation of the communications outlets themselves is occurring as the replacement proceeds.

Navigational equipment (VOR/DME and VORTAC) replacement was 95% completed, and this remotely monitored second generation equipment is in operation. In 1984, a contract was awarded for upgrading nondirectional beacons (NDB). Tests and studies of GPS performance have been completed, leading the way for development of a safe and accurate GPS monitoring system.

Many instrument landing systems (ILS) vacuum-tube components have been replaced. Where demand increases dictate, systems have been upgraded to higher categories. A contract was awarded for remote maintenance monitoring retrofit of the ILS. The first contract for the new microwave landing system (MLS) has been awarded. Operational procedures for its use are being finalized. International standards for the DME/P portion of the MLS have been incorporated into ICAO Annex 10.

Approach lighting systems have been installed as required for runway upgrades and in conjunction with electronic landing systems. A contract has been awarded for improved remote radio control of lighting systems from the tower cab and aircraft. A contract was awarded in 1985 for the new precision approach path indicators (PAPI). The approach lighting system improvement program, providing for frangible supports and some upgraded components, was started in 1984 and is proceeding on a regional priority schedule.

Establishment of 125 direction finders (DF) was completed and the procurement process for additional establishments and replacements has started. The contracts for replacement of ASR 4/5/6 tube-type terminal radars and vacuum-tube components of long-range radars have been awarded. Mode S equipment acquisition for 137 locations is also underway. As a temporary measure, an interim ASDE has been provided for

Anchorage, Alaska. The contract for replacement of all tube-type ASDE and establishment of 17 qualifying new locations was awarded in 1985.

NEAR TERM (TO 1990)

The solid-state replacement of ground-air communications equipment will be completed for towers and FSS communications outlets. The networking studies will be updated and communications network consolidations will be underway.

The retrofit of DVORs with RMM, establishment of VOTs, and VOT replacement will all be completed. Conversion of VORs to DVORs will continue. The establishment of required NDBs will be completed. The monitoring system for GPS will be defined, the acquisition package completed and the contract awarded. LORAN C monitors will be implemented to provide non-precision approach correction data.

ILS establishments and ILS tube-type component replacement will be completed. One hundred and seventy-eight MLS systems, contracted in 1984, will be implemented; and a contract for up to 500 additional systems is anticipated. Installation of these systems will have begun.

The initially procured RVR systems will be installed, the follow-on procurement awarded, and implementation of the second buy will be underway.

Implementation of visual navaids, including PAPI systems, and the approach light improvement program will also continue.

Direction finder establishment will continue, along with the co-location of facilities, to reduce overhead operational costs.

The implementation of the first 137 Mode S systems will be underway and initial weather services available over data link. Long-range radar tube-type component upgrade will be completed. Terminal radar replacement and establishment, ASR 7/8 relocation and ASDE implementation will be nearly complete. The ARSR 4 contract will be awarded. Contracts for weather radars (NEXRAD & TDWR) will be awarded, with implementation well underway.

LONG TERM (TO 2000)

Communication network consolidation will be completed. Seventy new VOR/DMEs will be established. The relocation of some VORs may be required to accommodate restructuring of the airways, and co-locating VOTs will be accomplished where possible. The GPS monitors will be in place. Additional LORAN C stations will be implemented to improve signal coverage for the Gulf of Mexico and the mid-continent.

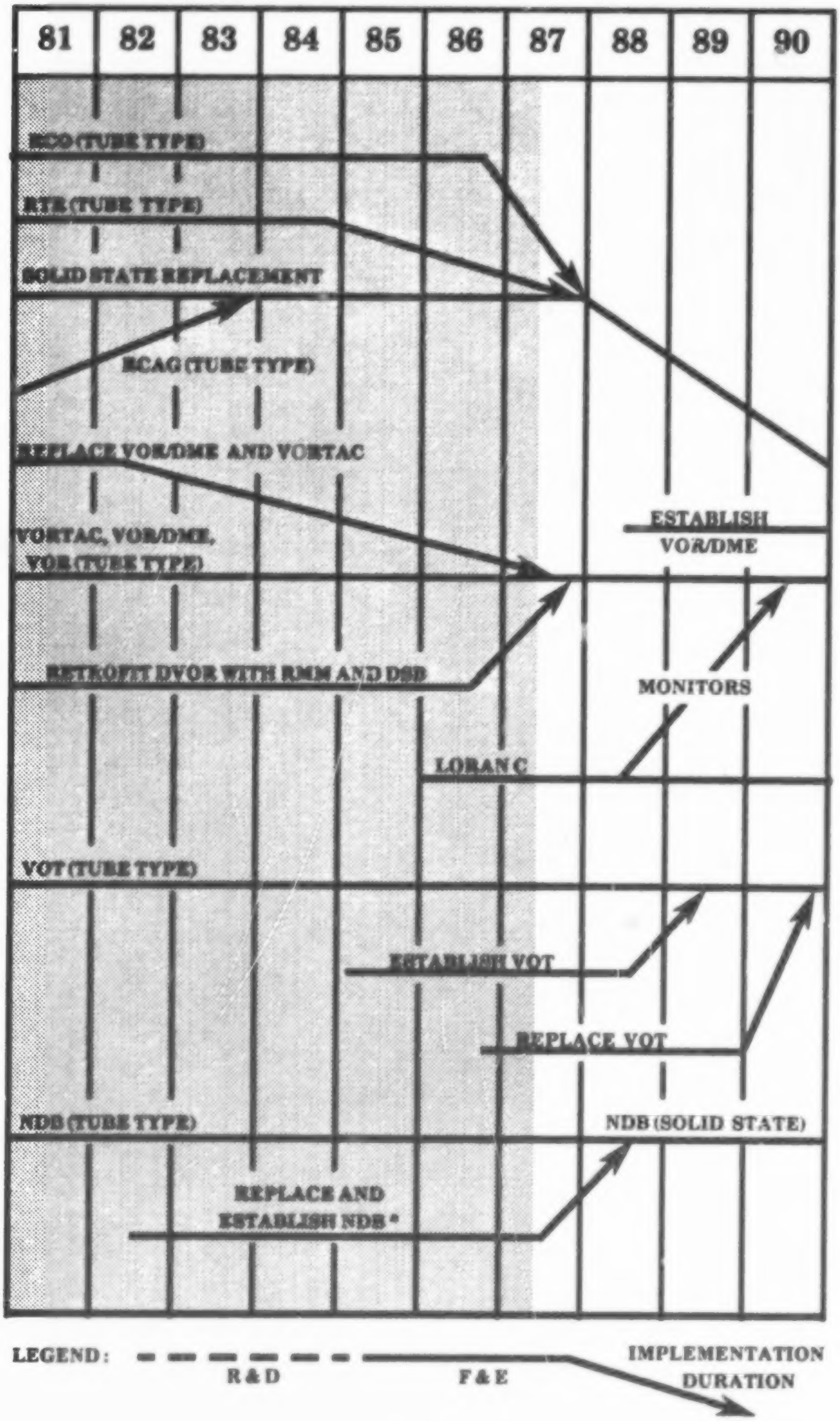
Implementation of MLS and decommissioning of ILS will be completed. Implementation of RVR systems will be complete. Implementation of visual approach and landing aids will continue. The approach lighting system improvement program will be completed. Establishment and co-location of DFs with other equipment to share buildings and utilities will be completed.

Implementation of NEXRAD and TDWR weather radars will be complete. ASR 7/8 radars will be relocated. Thirty ASDE 3s, 48 ARSR 4s and 197 Mode S units will be implemented. Data link coverage will extend down to 6,000 feet above mean sea level or minimum en route instrument flight rule altitude, whichever is higher, providing weather and automated air traffic services to lower flying aircraft. Aviation weather will be available to pilots on request through data link. Mode S data link will also provide the medium for transmission of ATC clearance to pilots in the cockpit.

In designated airspace, aircraft will be equipped with Mode S to derive the benefits of automated services. Weather radar information will be improved as the FAA weather network (including NEXRAD) becomes operational.

FAA en route search radar may be decommissioned if all aircraft are transponder equipped while operating above 6,000 feet and required FAA weather radar information is obtained from NEXRAD weather radar facilities.

The following diagrams and maps describe the evolution of the system.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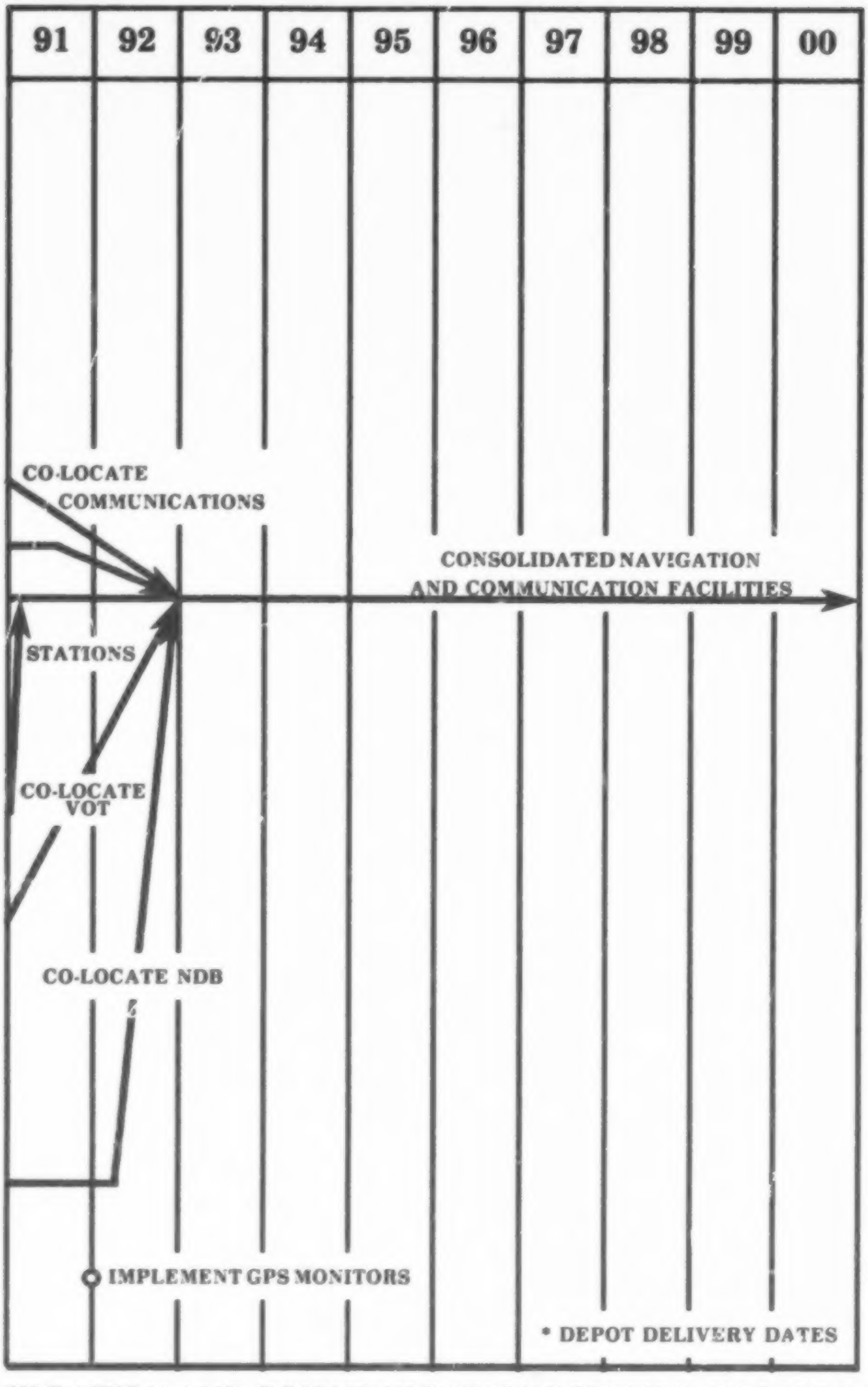
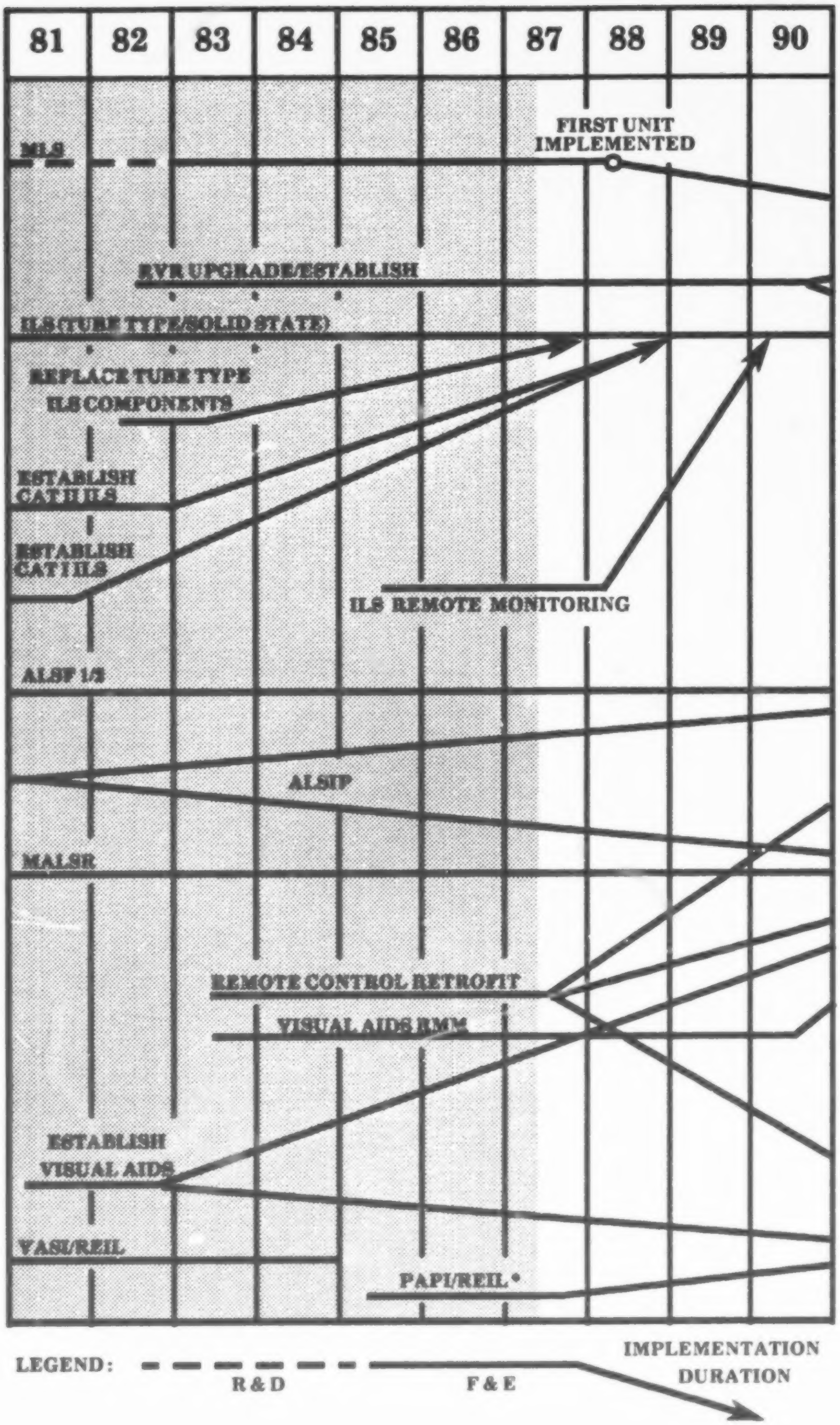
90
RCO (TUBE TYPE)
RTR (TUBE TYPE)
SOLID STATE REPLACEMENT
RCAG (TUBE TYPE)
REPLACE VOR/DME AND VORTAC
ESTABLISH VOR/DME
VORTAC, VOR/DME, VOR (TUBE TYPE)
RETROFIT DVOR WITH RMM AND DSB
MONITORS
LORAN C
VOT (TUBE TYPE)
ESTABLISH VOT
REPLACE VOT
NDB (TUBE TYPE)
NDB (SOLID STATE)
REPLACE AND ESTABLISH NDB*
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



NAVIGATION AND COMMUNICATIONS SYSTEM EVOLUTION

176



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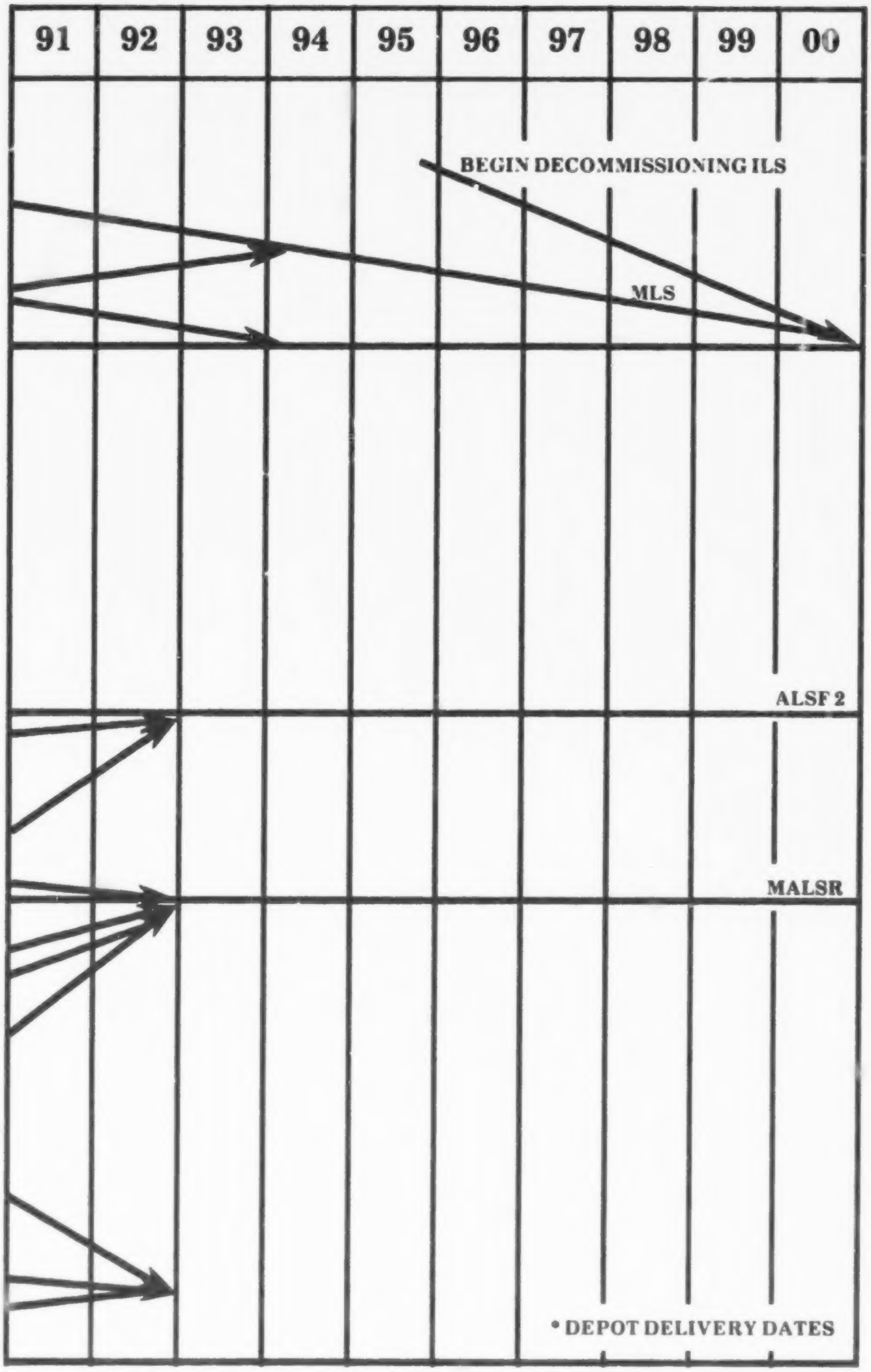
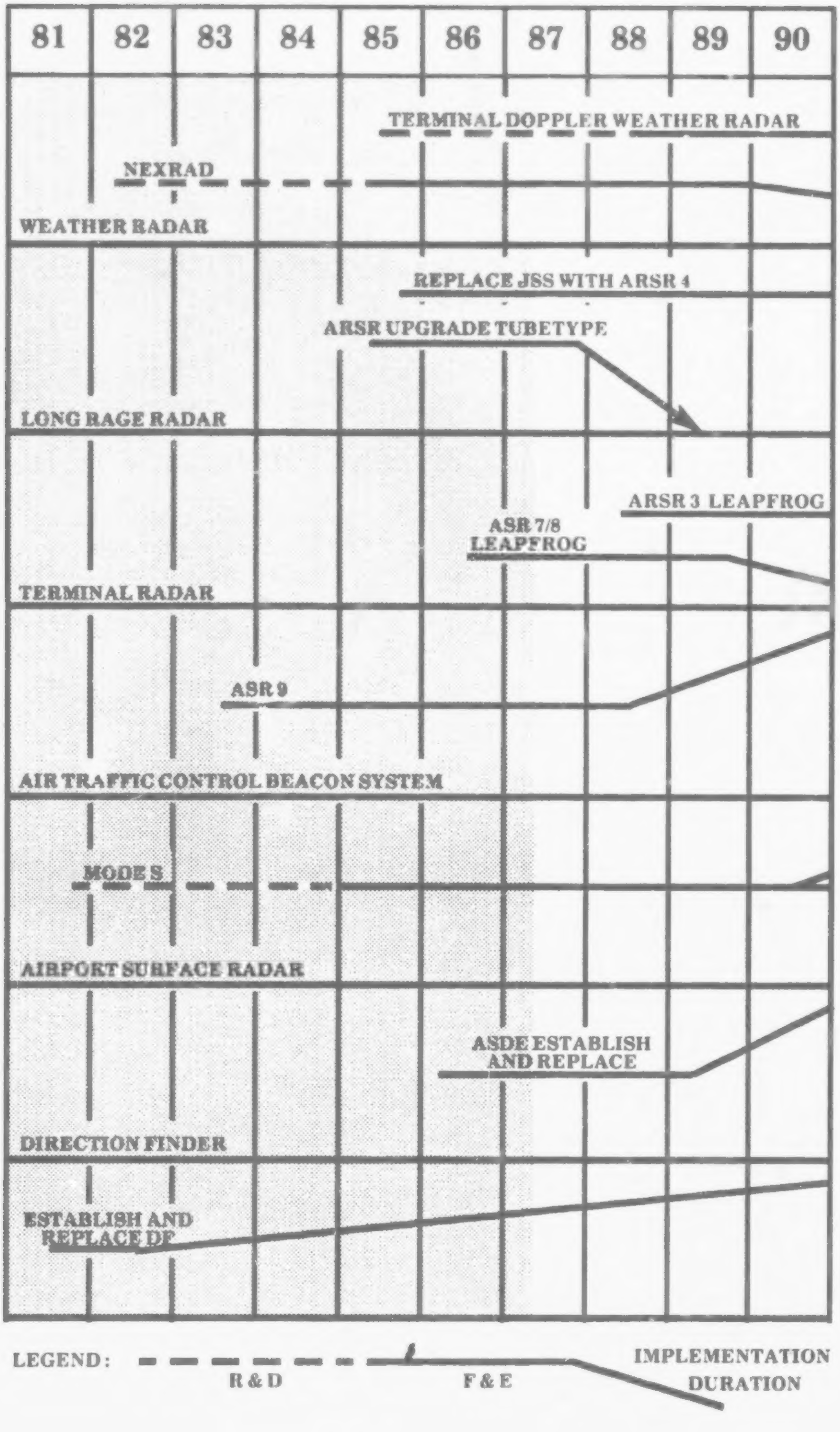
177



LANDING SYSTEMS EVOLUTION

178


81
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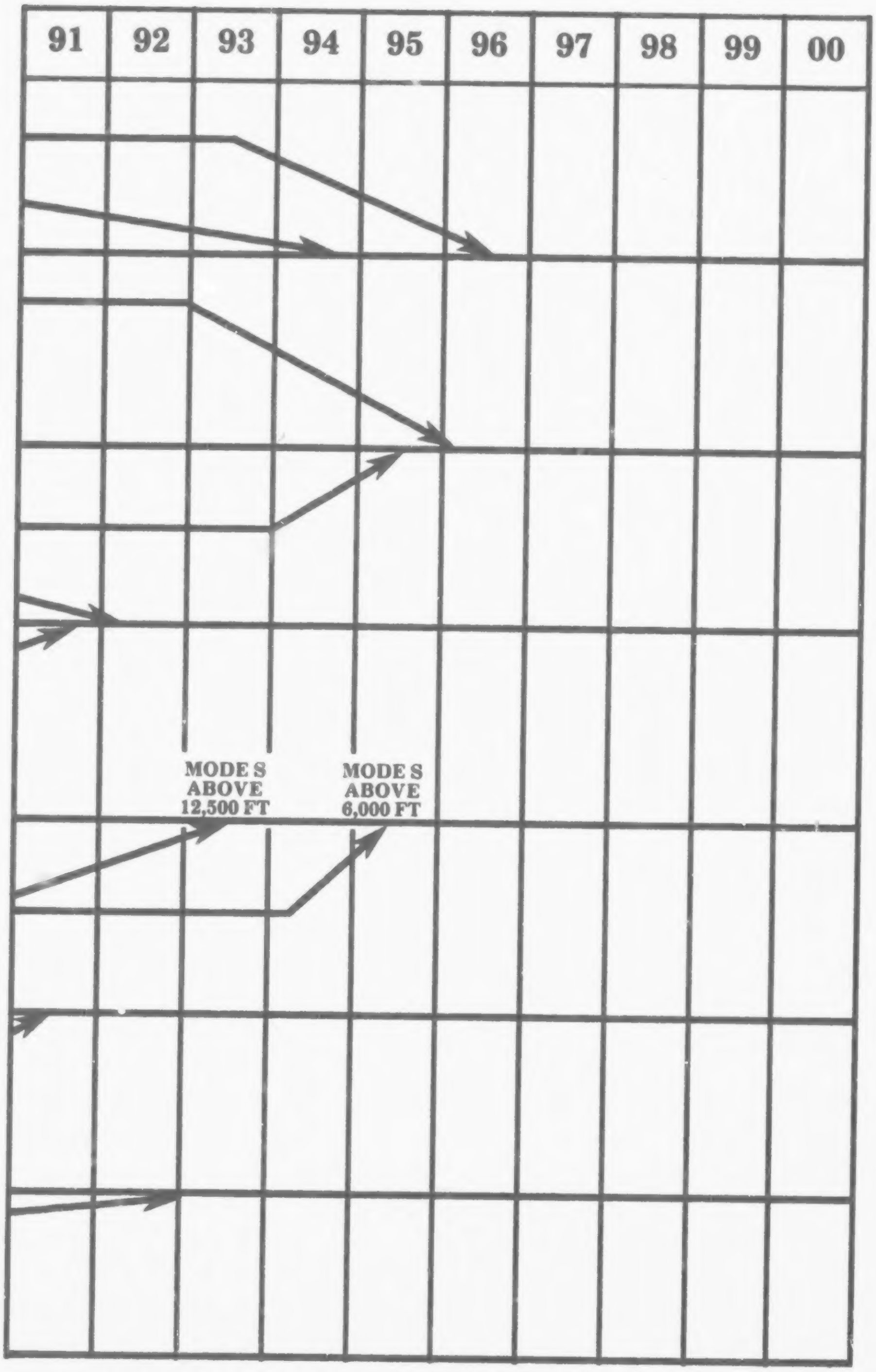
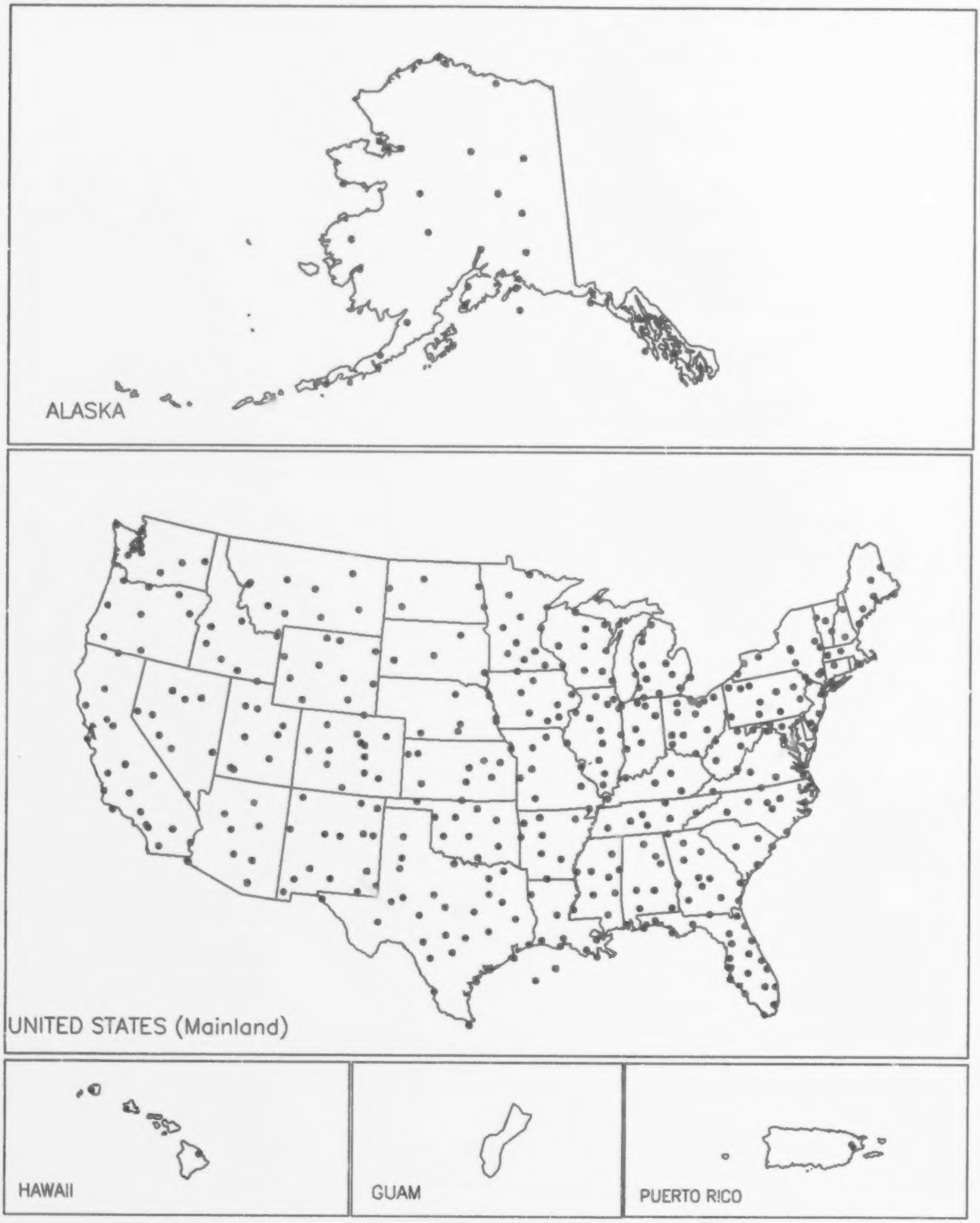
TERMINAL DOPPLER WEATHER RADAR
NEXRAD
WEATHER RADAR
REPLACE JSS WITH ARSR 4
ARSR UPGRADE TUBETYPE
LONG RAGE RADAR
ARSR 3 LEAPFROG
ASR 7/8 LEAPFROG
TERMINAL RADAR
ASR 9
AIR TRAFFIC CONTROL BEACON SYSTEM
MODE S
AIRPORT SURFACE RADAR
ASDE ESTABLISH AND REPLACE
DIRECTION FINDER
ESTABLISH AND REPLACE DF
LEGEND:
R & D
F & E
IMPLEMENTATION DURATION



SURVEILLANCE SYSTEMS EVOLUTION

THIS MAP DEPICTS THE LOCATION OF REMOTE CENTER AIR/GROUND (RCAG) SYSTEMS. IN 1981 THERE WERE 550 RCAGs PROVIDING COMMUNICATION BETWEEN THE AIR TRAFFIC CONTROLLERS AT THE AIR ROUTE TRAFFIC CONTROL CENTERS AND THE PILOTS.

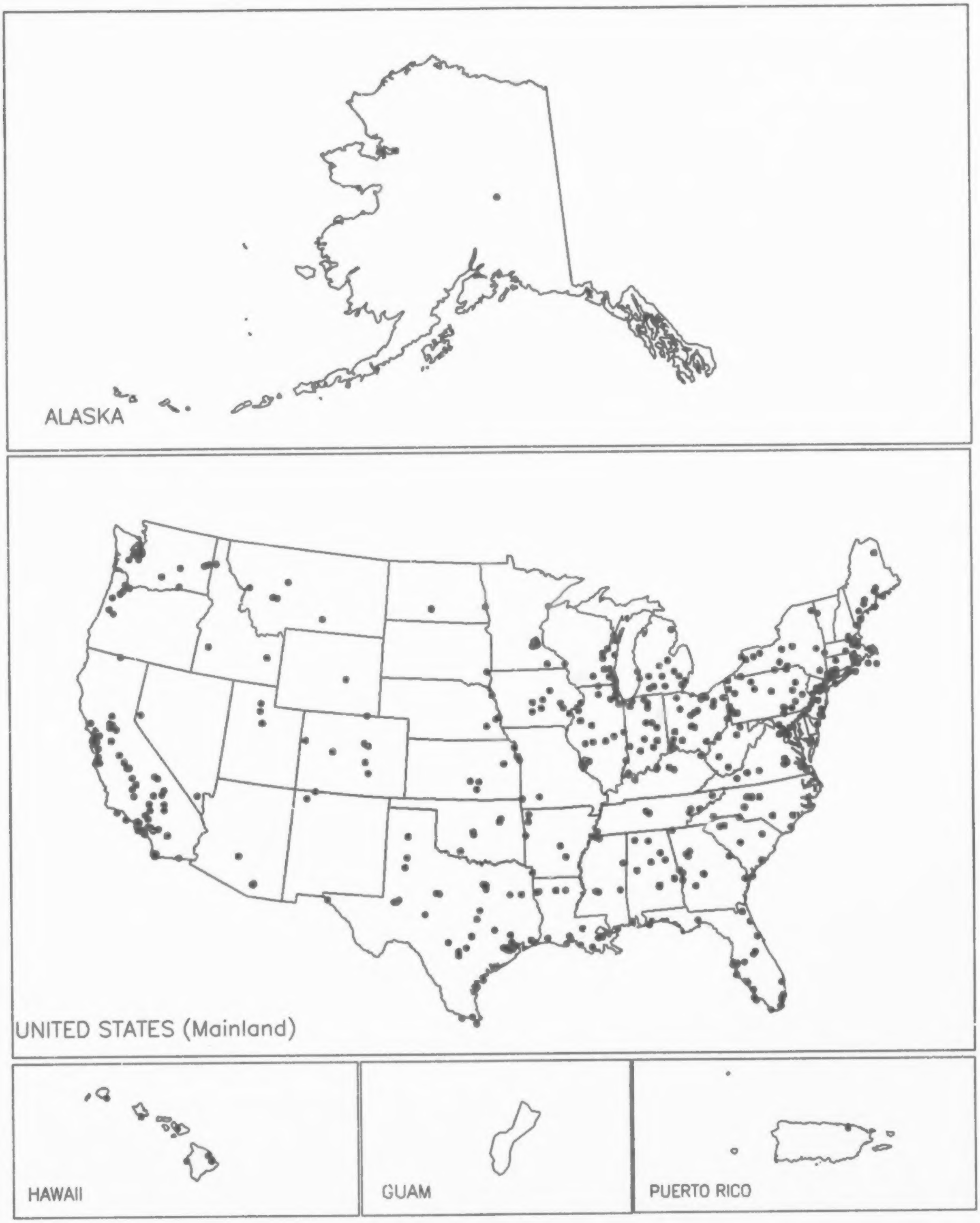
CURRENTLY, THERE ARE 599 RCAGs. CO-LOCATION OF COMMUNICATION FACILITIES WITH EACH OTHER OR OTHER FAA FACILITIES, BASED ON NETWORK ANALYSIS AND INDIVIDUAL COST VS. BENEFIT STUDIES, WILL REDUCE THE NUMBER OF INDIVIDUAL SITES.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

CURRENT SYSTEM
EN ROUTE COMMUNICATIONS

THIS MAP DEPICTS THE LOCATION OF 765 REMOTE TRANSMITTERS/ RECEIVERS (RTR) EXISTING IN 1985. RTRs PROVIDE RADIO COMMUNICATIONS BETWEEN AIR TRAFFIC CONTROLLERS AT TERMINAL FACILITIES AND PILOTS.

CO-LOCATION OF COMMUNICATION FACILITIES WILL REDUCE THE NUMBER OF INDIVIDUAL SITES.


ALASKA
UNITED STATES (Mainland)
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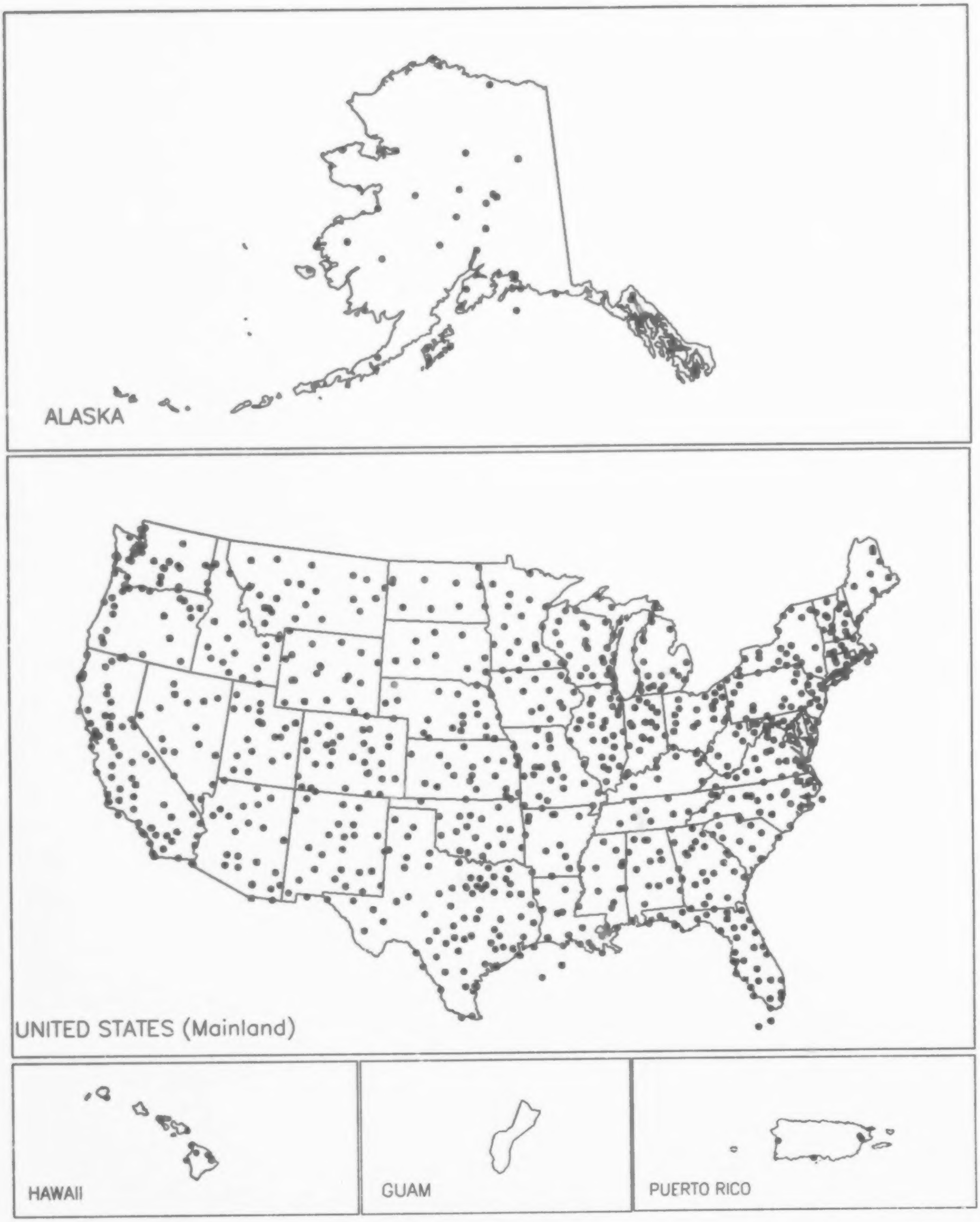
PUERTO RICO

**CURRENT SYSTEM
TERMINAL COMMUNICATIONS**

THIS MAP DEPICTS THE LOCATION OF REMOTE COMMUNICATION OUTLETS (RCO). TWO HUNDRED FIFTY ARE CO-LOCATED WITH VORs/VORTACs. THERE WERE 1,230 RCOs PROVIDING RADIO COMMUNICATION SERVICES BETWEEN FLIGHT ADVISORY SPECIALISTS AT FLIGHT SERVICE STATIONS AND PILOTS, AIRBORNE OR ON THE GROUND.

CURRENTLY, WE HAVE 1,302 RCOs IN THE SYSTEM PROVIDING THAT SERVICE. CO-LOCATION OF COMMUNICATION FACILITIES WILL REDUCE THE NUMBER OF INDIVIDUAL SITES.


ALASKA
UNITED STATES (Mainland)
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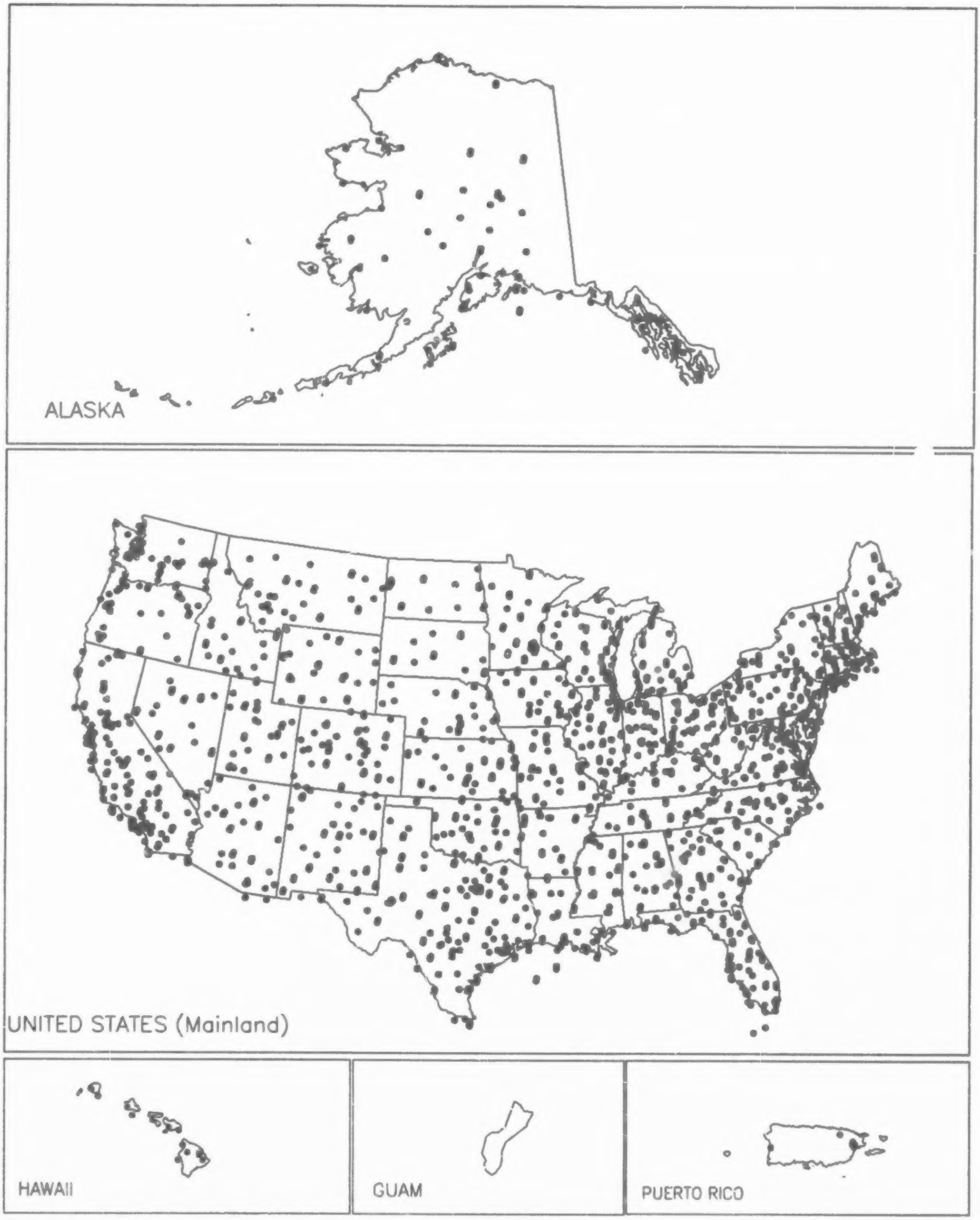
CURRENT SYSTEM
FLIGHT SERVICE COMMUNICATIONS

THIS MAP DEPICTS CONSOLIDATED COMMUNICATION SYSTEMS BY THE YEAR 2000. DURING 1986 TO 2000, THE 2,680 TOTAL COMMUNICATION SYSTEMS WILL BE CONSOLIDATED INTO A LESSER NUMBER OF COMMUNICATION FACILITIES PROVIDING SERVICE BETWEEN PILOTS AND FSSs, TERMINALS, AND ARTCCs.

CO-LOCATION OF COMMUNICATION FACILITIES WITH EACH OTHER AND OTHER TYPES OF FAA FACILITIES, BASED ON NETWORKING AND ECONOMIC ANALYSIS, IS EXPECTED TO REDUCE THE NUMBER FROM 2,680 TO APPROXIMATELY 2,100.


ALASKA
UNITED STATES (Mainland)
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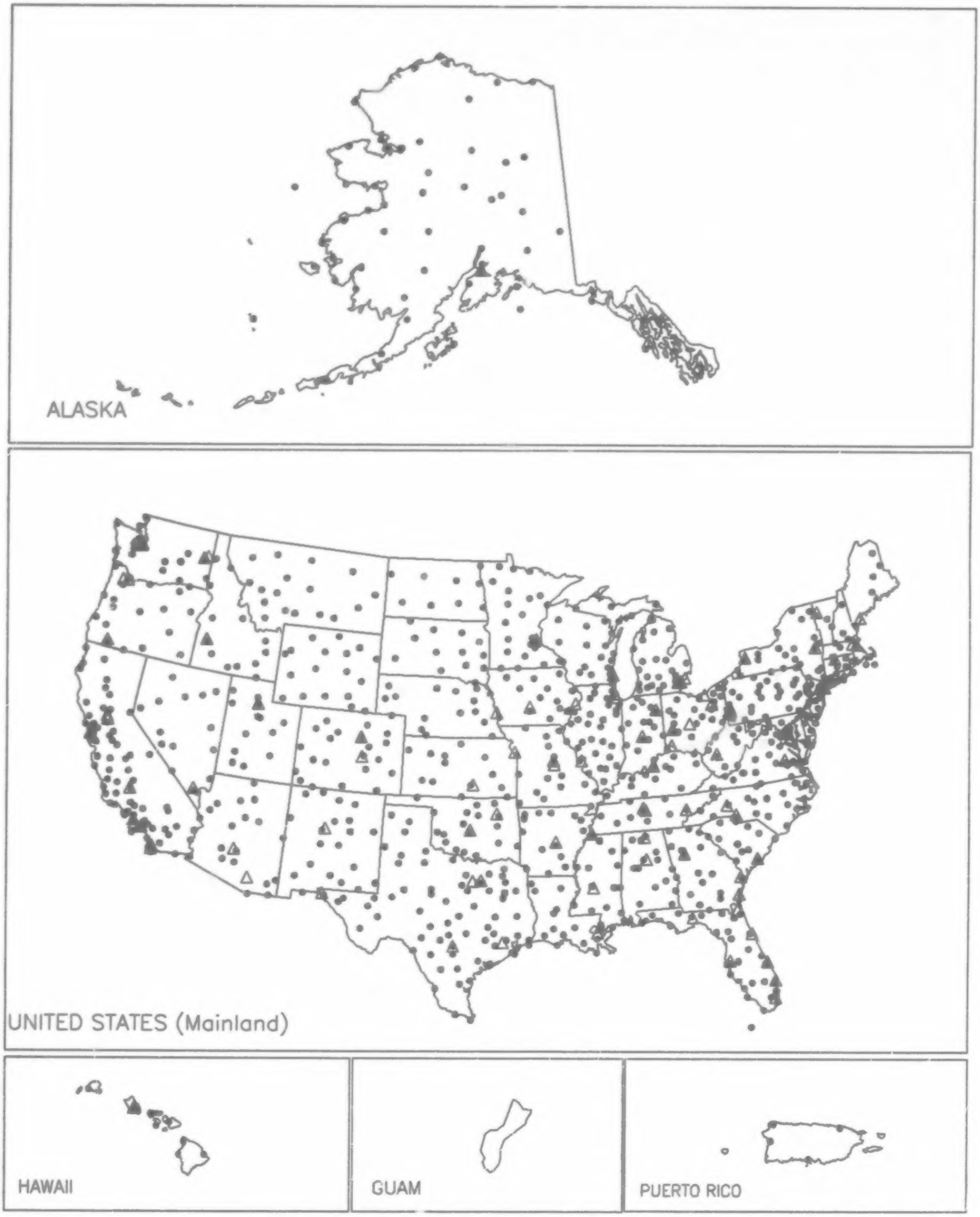
2000 SYSTEM
AIR/GROUND COMMUNICATIONS

THERE ARE APPROXIMATELY 950 VHF OMNIDIRECTIONAL RANGE (VOR) EQUIPMENT IN SEVERAL DIFFERENT CONFIGURATIONS. THESE INCLUDE VOR, VOR/DME, AND VOR WITH TACTICAL AIR NAVIGATION EQUIPMENT. THE CURRENT PROGRAM PROVIDES FOR REPLACEMENT OF ALL EXISTING TUBE-TYPE SYSTEMS WITH SOLID STATE HAVING RMM CAPABILITY. AN ADDITIONAL 70 VOR/DMEs WILL BE ESTABLISHED BY THE YEAR 2000, IN ADDITION TO CONVERTING 75 TO DOPPLER VOR WITH RMM CAPABILITY. THIS MAP DEPICTS THE LOCATIONS OF THE SYSTEMS BY THE YEAR 2000.

THIS MAP ALSO DEPICTS THE VHF OMNI DIRECTIONAL RANGE TEST (VOT) EQUIPMENT FOR THE YEAR 2000. THESE SYSTEMS PROVIDE A SIGNAL FOR CALIBRATION AND VERIFICATION OF AIRCRAFT VOR EQUIPMENT.

● VOR EQUIPMENT
△ VOT EQUIPMENT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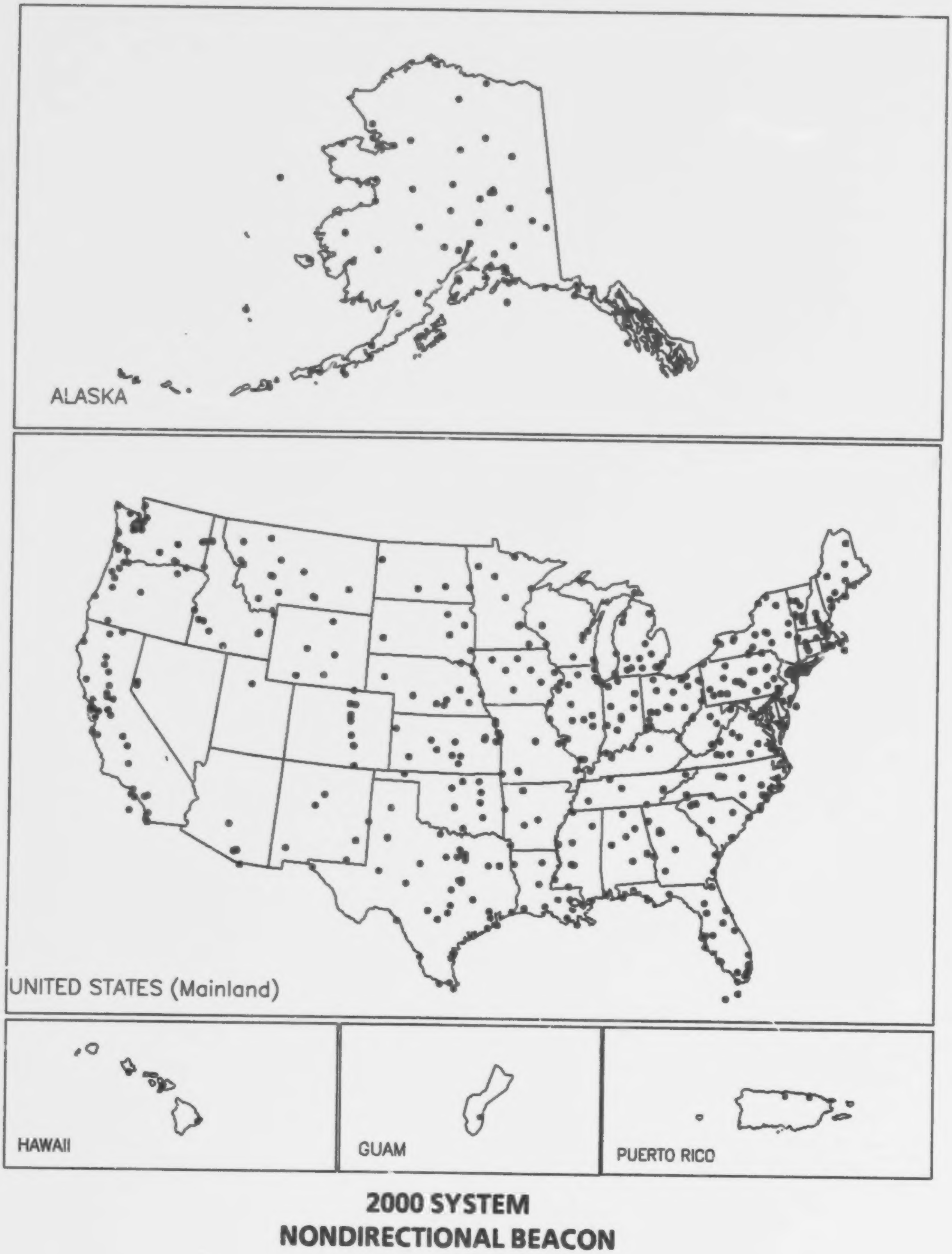
2000 SYSTEM
VHF OMNIDIRECTIONAL RANGE AND
VHF OMNIDIRECTIONAL RANGE TEST

190

THERE WERE OVER 200 OPERATIONAL NONDIRECTIONAL BEACON SYSTEMS IN 1981 USED FOR EN ROUTE NAVIGATION AND APPROACH FIXES. NONDIRECTIONAL BEACONS USED AS PART OF AN INSTRUMENT LANDING SYSTEM (ILS) ARE NOT INCLUDED ON THIS MAP. BY 2000, ALL NEW SYSTEMS WILL BE SOLID STATE.

TOTAL POPULATION OF NDB EQUIPMENT BY 2000 WILL BE 682, WHICH INCLUDES THE NONDIRECTIONAL BEACONS USED AS PART OF INSTRUMENT LANDING SYSTEMS.


ALASKA
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2000 SYSTEM
NONDIRECTIONAL BEACON

THIS MAP SHOWS THE TOTAL ILS POPULATION TO BE ESTABLISHED BY 1990. THIS REPRESENTS THE CURRENT PLAN TO ESTABLISH APPROXIMATELY 35 FULL AND PARTIAL ILSs. PHASEOUT OF ILSs WILL START AFTER 1995 AND WILL BE COMPLETED BY APPROXIMATELY 2000.

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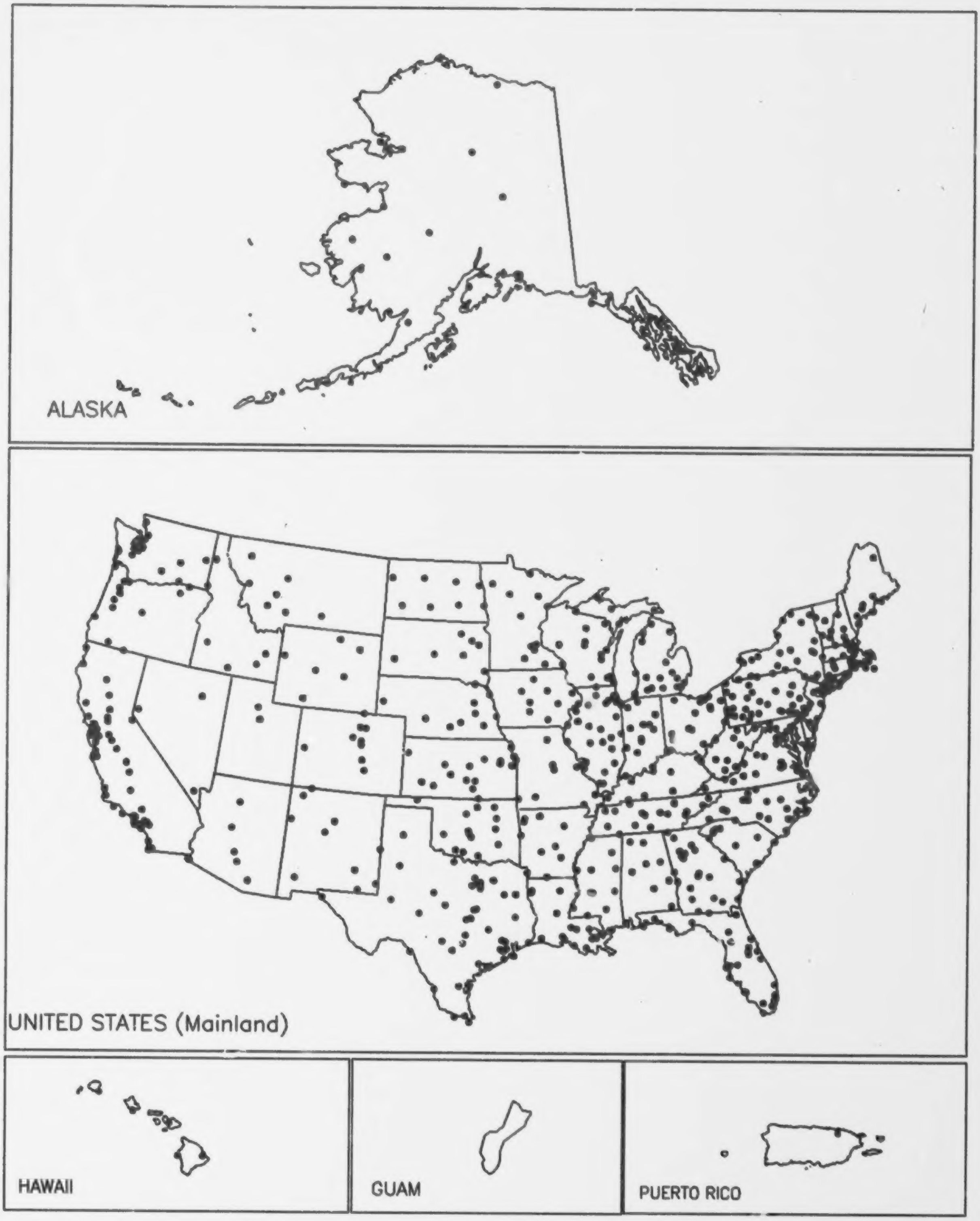
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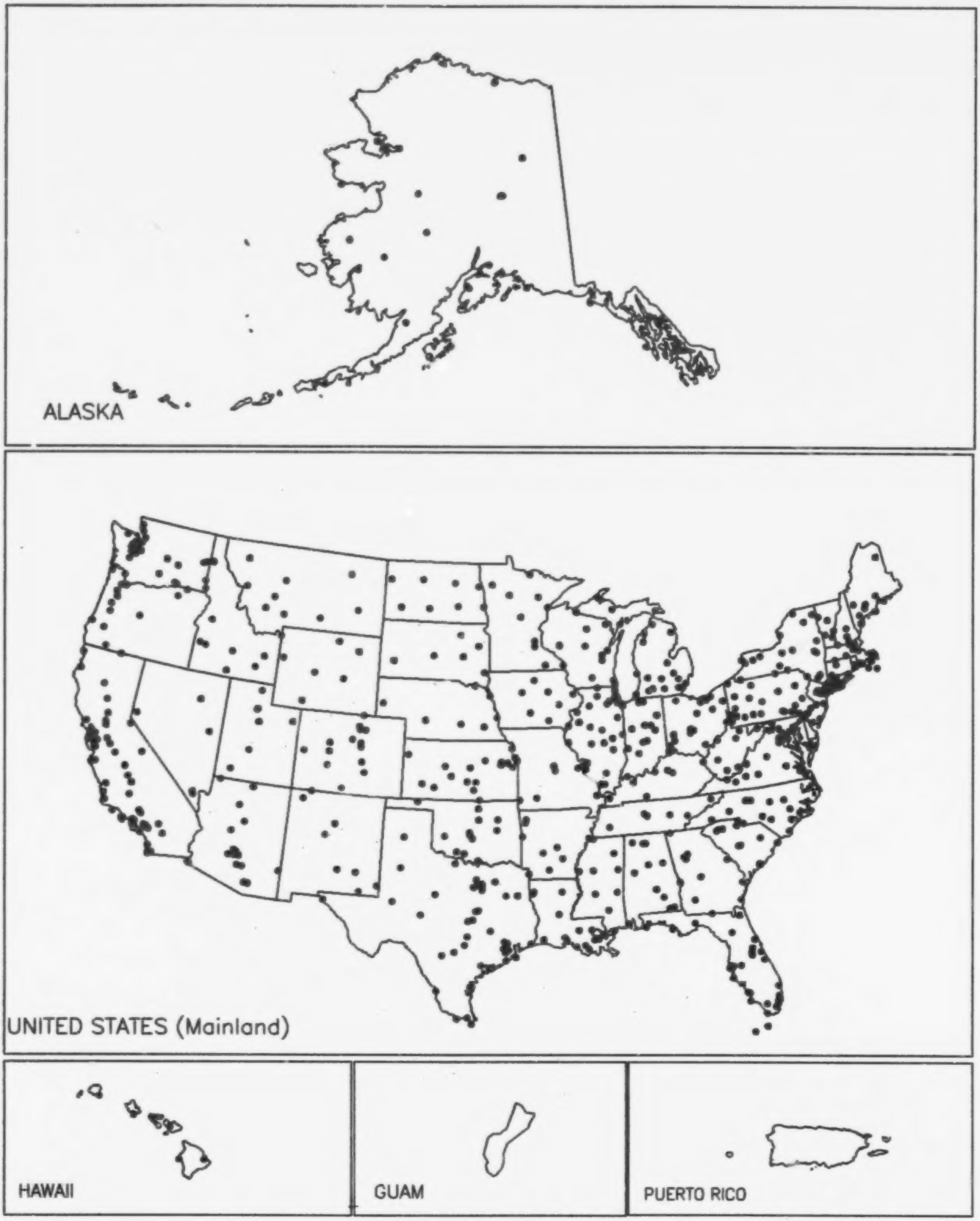
1990 SYSTEM
INSTRUMENT LANDING SYSTEMS

THE MICROWAVE LANDING SYSTEM (MLS) IS A NEW ELECTRONIC ALL-WEATHER PRECISION APPROACH AND LANDING SYSTEM DEVELOPED AS AN INTERNATIONAL REPLACEMENT FOR ILS. THE PROGRAM WAS FIRST SCHEDULED FOR FUNDING IN FY-83 AND WILL CONSIST OF APPROXIMATELY 1,250 SYSTEMS BY THE YEAR 2000. IMPLEMENTATION OF MLS REQUIRES THAT THE ILS PROGRAM GROWTH BE MINIMIZED.

CURRENT PLANS AND BUDGETING ARE TO ESTABLISH APPROXIMATELY 178 MLSs BY 1990. THE LOCATIONS SHOWN ARE SUBJECT TO CHANGE BASED ON REFINEMENTS TO THE NETWORKING CONCEPT AND COMPLETION OF THE ILS PROGRAM.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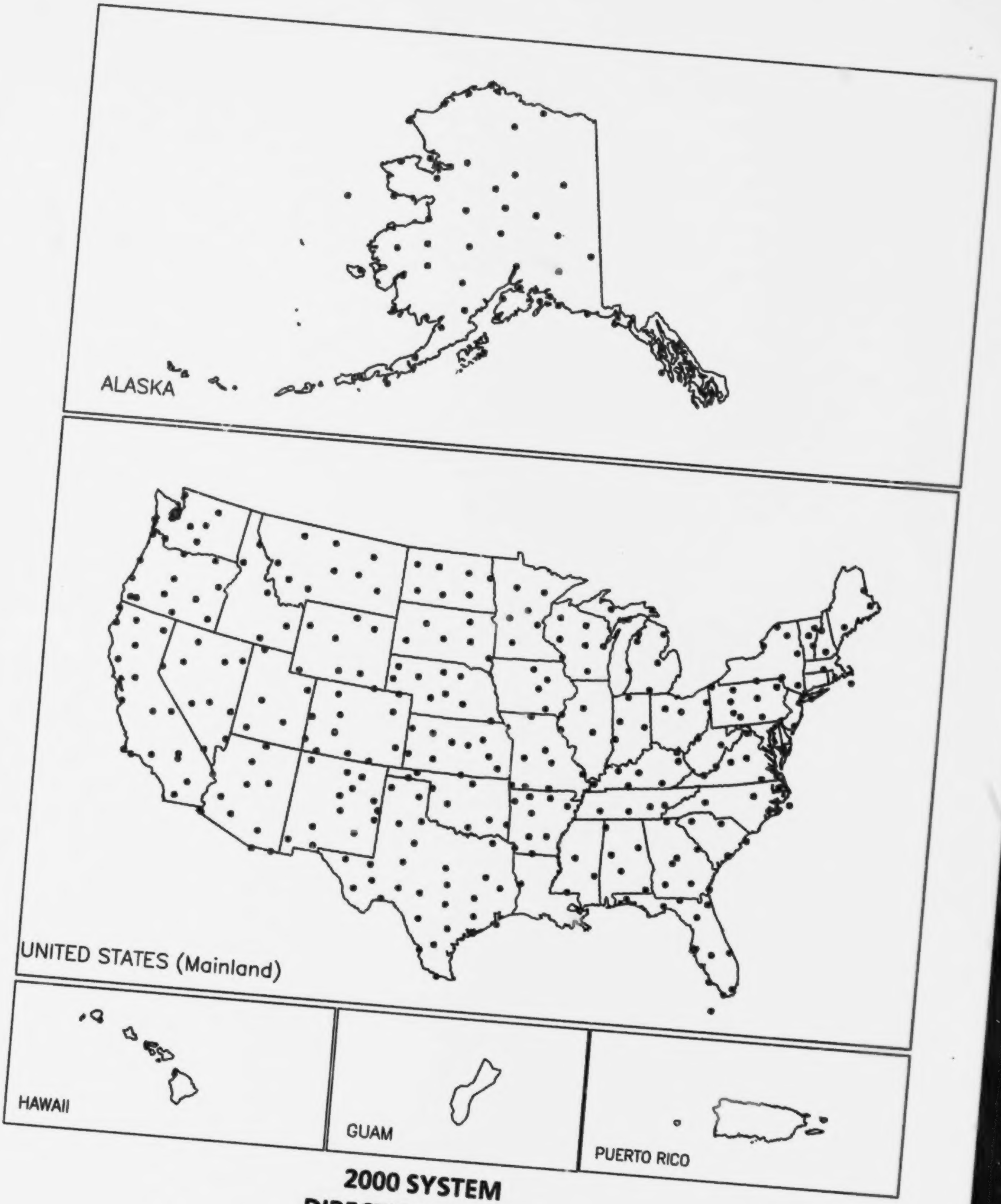
1990 SYSTEM
MICROWAVE LANDING SYSTEMS

THIS MAP DEPICTS THE LOCATION OF DIRECTION FINDERS (DF). DFs ARE VHF RADIO RECEIVERS USED TO TAKE BEARINGS ON AIRCRAFT TRANSMITTERS. IN 1981 THERE WERE 175 DFs. IN 1990 THERE WILL BE 350 DFs, AND 19 DFs WILL BE ADDED BETWEEN 1990 AND 2000. THE LOCATION OF THESE SITES WILL BE DETERMINED AT A LATER DATE. ALL EXISTING TUBE-TYPE EQUIPMENT WILL BE REPLACED WITH SOLID STATE HAVING RMM CAPABILITY. DF POPULATION IN 1985 WAS 234.

197


ALASKA
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**2000 SYSTEM
DIRECTION FINDERS**

IN 1985 THERE WERE 198 AIRPORT SURVEILLANCE RADARS, 110 LONG RANGE RADARS AND 21 BEACON ONLY SITES.

BY THE YEAR 2000 NETWORK STUDIES INDICATE THERE SHOULD BE 241 AIRPORT SURVEILLANCE RADARS, 119 LONG RANGE RADARS, AND 32 BEACON ONLY SITES.

△ AIRPORT SURVEILLANCE RADAR SITES

● LONG RANGE RADAR SITES

☐ BEACON-ONLY SITES

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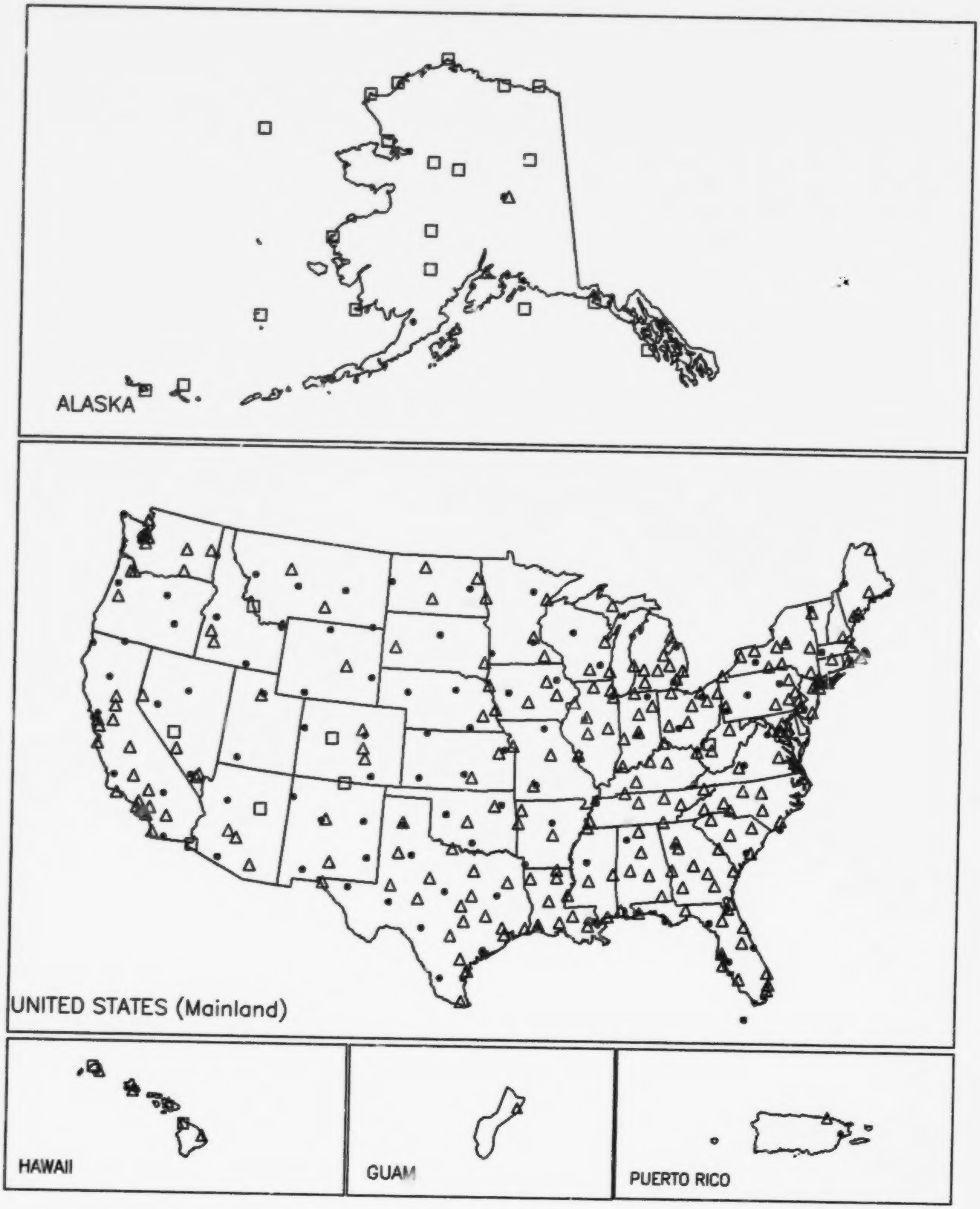
199


ALASKA
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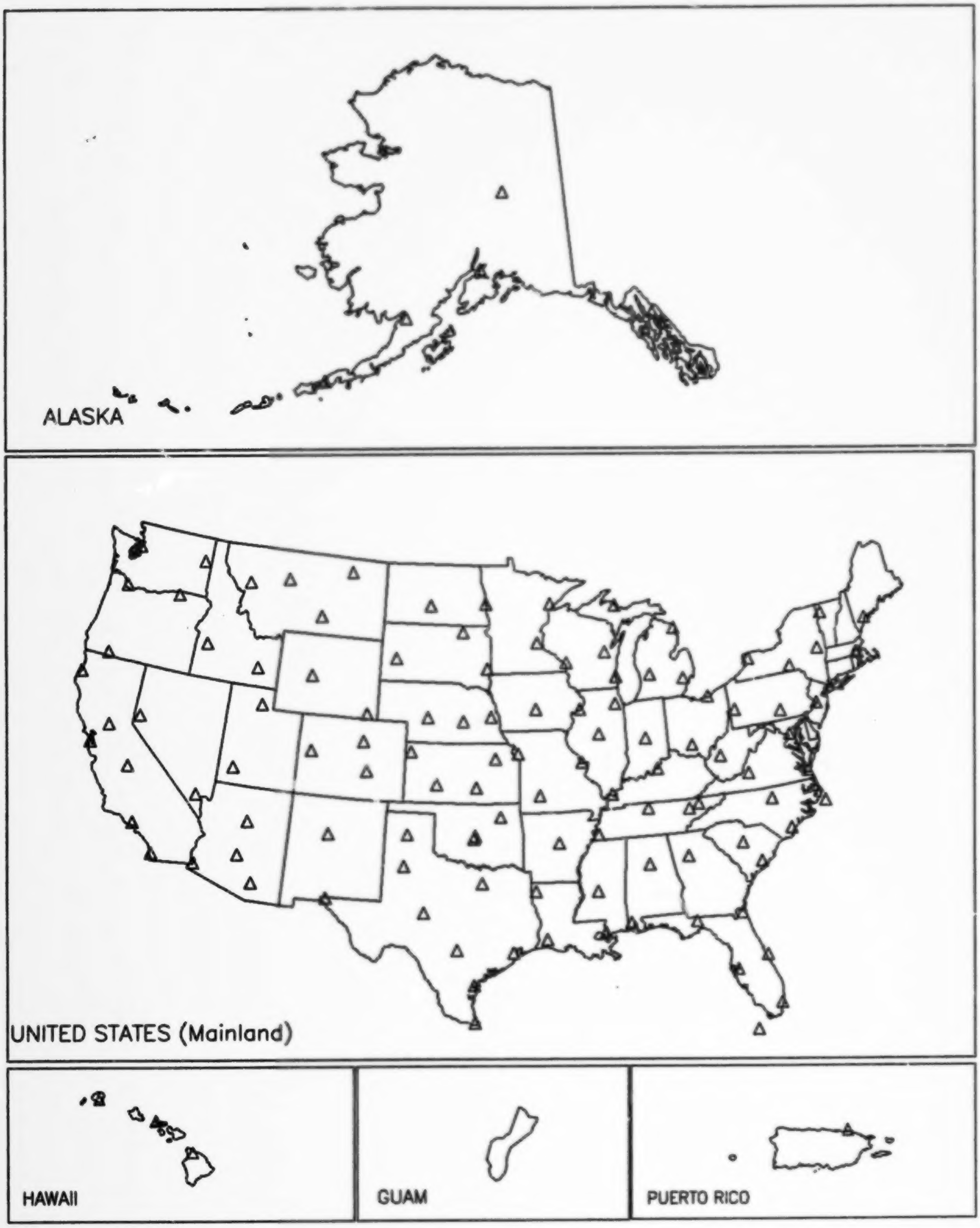
2000 SYSTEM
SURVEILLANCE NETWORK

THE FUTURE AVIATION WEATHER RADAR SENSOR NETWORK WILL PROVIDE IMPROVED WEATHER INFORMATION AT 10,000 FEET AND ABOVE FOR EN ROUTE AREAS AND APPROACHING THE SURFACE OF DESIGNATED AIRPORTS. THE SENSOR NETWORK WILL BE COMPRISED OF SELECTED FAA TERMINAL RADARS WITH WEATHER CHANNELS AND NEXT GENERATION WEATHER RADARS (NEXRAD).


ALASKA
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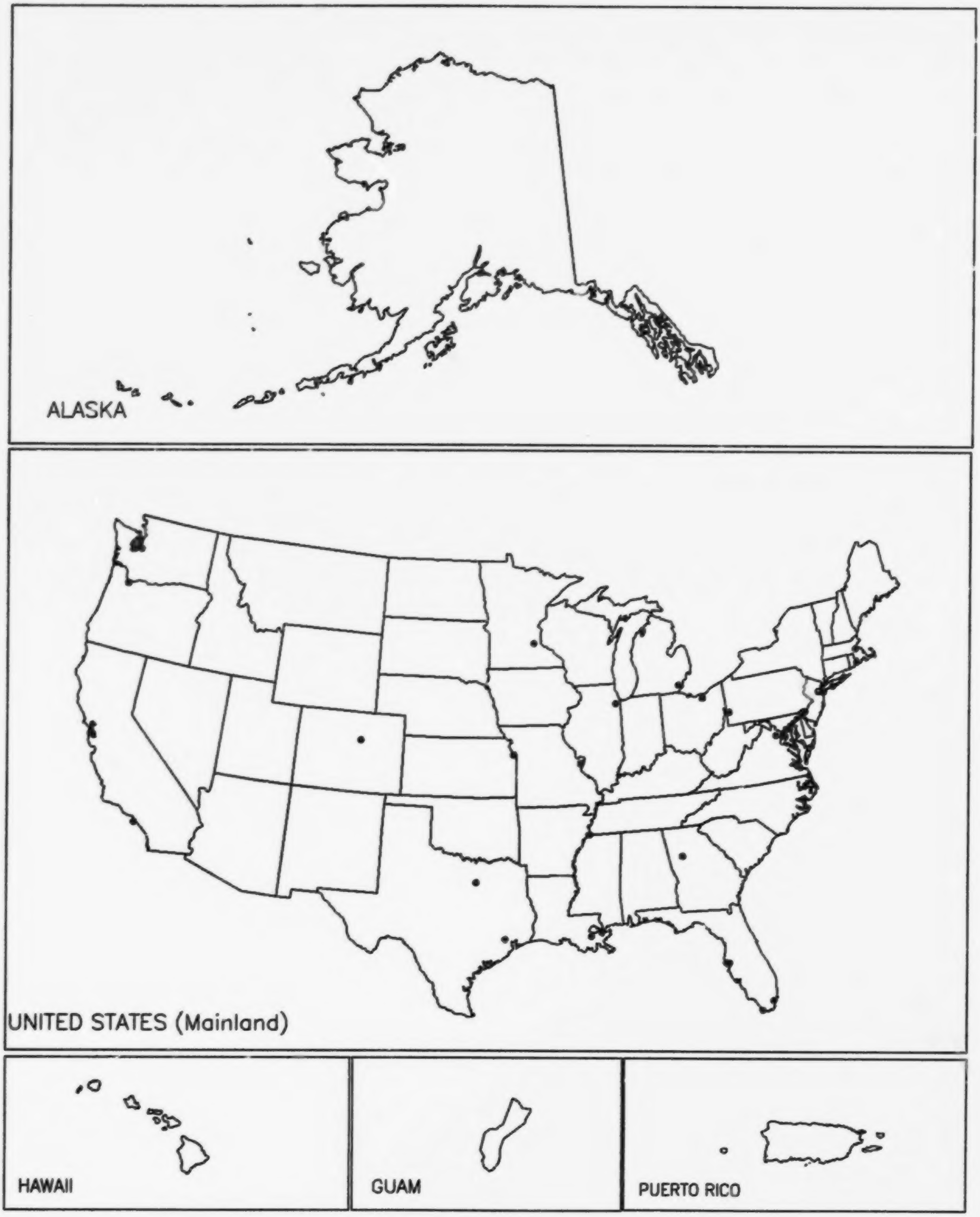
2000 SYSTEM
NEXT GENERATION WEATHER RADAR (NEXRAD) NETWORK

THERE ARE CURRENTLY 13 AIRPORT SURFACE DETECTION EQUIPMENT (ASDE) SYSTEMS. THESE WILL BE REPLACED BY SOLID-STATE ASDE 3s DURING 1986-1991. ADDITIONAL ESTABLISHMENTS WILL INCREASE THE NUMBER OF ASDEs TO 30 SYSTEMS BY THE YEAR 1991.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GUAM
PUERTO RICO

1990 SYSTEM
AIRPORT SURFACE DETECTION EQUIPMENT

RETURN ON THE INVESTMENT

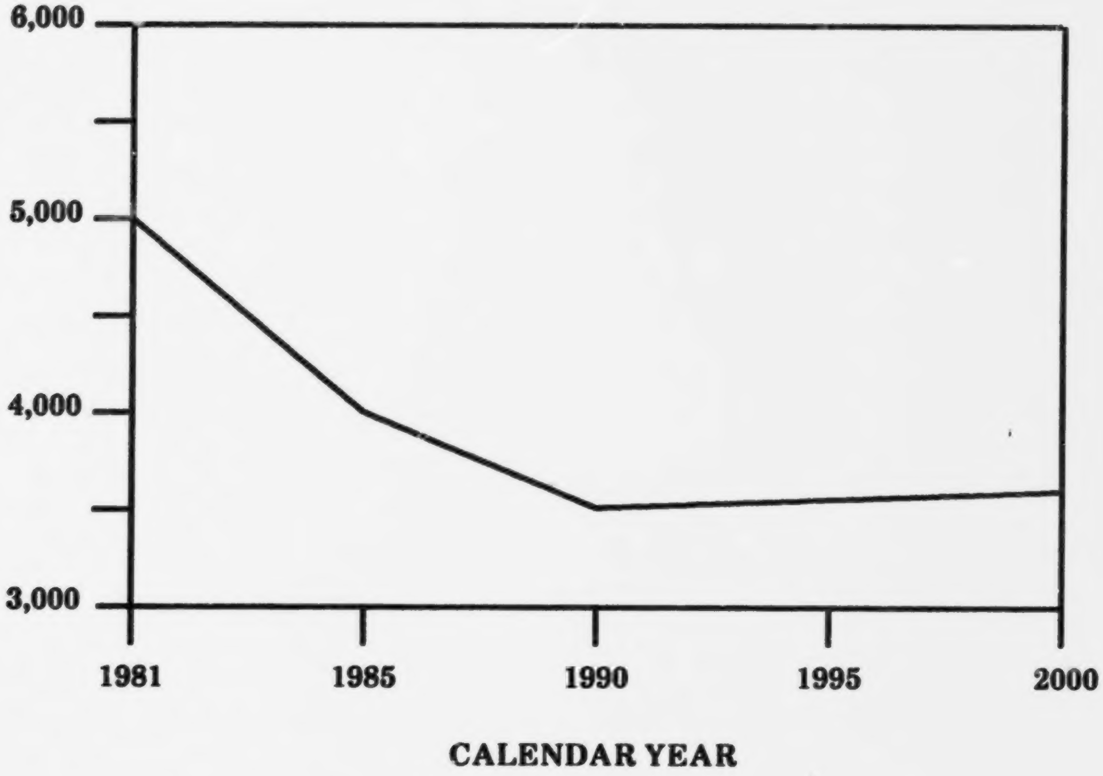
As a result of these planned actions, major improvements in service, system availability, and extended reliability will be achieved; and operating costs will be substantially reduced.

FIELD EMPLOYMENT

Employment levels reflect Airway Facilities sector manager and subordinate positions required to staff the ground-to-air system. Air Traffic employment is not required for these remote systems.

During the next 13 years, the ground-to-air system will undergo changes in hardware, software, and plant improvements. These will result in changes within Airway Facilities as shown in the chart below.

For this system, changes since 1981 will have the net effect of decreasing current Airway Facilities personnel requirements at FAA field facilities by 28 percent in the year 2000.



AIRWAY FACILITIES EMPLOYMENT
(GROUND-TO-AIR SYSTEMS)

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SUMMARY OF FACILITY CHANGES

1981 – Airway Facilities employment for 11,640 facilities required a total of 5,057 people.

1985 – The reduction of Airway Facilities staffing has been due primarily to the implementation of VORTAC replacement, solid-state ILS, ground-to-air communications equipment replacement, and installation of remote maintenance monitoring. This has reduced personnel requirements to 3,985 positions.

1990 – Airway Facilities employment will continue to decrease during this time period in spite of the additional number of facilities established, such as MLS, NEXRAD, visual aids, airport surveillance radar (ASR), airport surface detection equipment (ASDE), VHF omnidirectional range test (VOT). Facility establishment increases in personnel will be offset by consolidation of facilities, replacement of vacuum-tube equipment with solid state, and remote-maintenance monitoring.

2000 – Staffing requirements through the year 2000 will experience a net increase due to TDWR, but are also offset by additional consolidation of facilities, reduction of facilities through networking, and the ultimate decommissioning of conventional ILS.

Outyear estimates are reviewed annually and are subject to revision.

GROUND-TO-AIR SYSTEMS
AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS

	1981	1985	1990	2000
Operations (Millions)	151.5	143.5	153.7	185.7
Airway Facilities Personnel	5,057	3,985	3,532	3,619
AF Productivity Quotient	29,958	36,010	43,516	51,313
Airway Facilities Personnel Costs (thousands)	$172,444	$135,889	$120,441	$123,408

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PROGRAM RELATIONSHIPS

The projects in this chapter modernize the air-ground communications equipment, navigation aids, approach and landing aids, and surveillance equipment which are the backbone of the National Airspace System. As an integrated set, they support the provision of all air traffic control, flight service station, and pilot direct services. They are related through the common objective of improving flight safety for all users, enhancing system reliability and maintainability, and ensuring the cost-effectiveness of the NAS. Moreover, they are bound by the requirement that existing or proposed services are available when and where needed and are tailored to the operational needs of the users within cost constraints.

The communications projects provide voice communication capability required by pilots for en route, terminal, and flight service station operations in a cost-effective manner through solid-state replacement and the formation of an integrated network of facilities.

The navigation projects similarly modernize both VOR and NDB-type ground based navigational aids in use today, ensuring en route safety and cost-effectiveness. Additionally, the Global Positioning System (GPS) Monitors project provides the capability for users of the NAS to avail themselves of wider-coverage, satellite-based navigational guidance provided by the Department of Defense.

The approach and landing systems projects modernize the electronic aids used by instrumented aircraft and the visual landing aids used by all. These aids improve airport arrival safety and airport capacity. Existing ILS-type aids have served the NAS well. Solid-state replacement of tube-type components and some limited expansion in the number of systems deployed are required for continued safe and cost-effective operations. Yet, future growth cannot be served by ILS, and MLS will be required to fill the void, improve capacity, and standardize operation by the turn of the century.

Surveillance projects modernize the radars used by air traffic control to detect aircraft location and weather and ensure aircraft separation in all areas where traffic density warrants such service. Individual projects address long-range radars (ARSR), airport surveillance radars (ASR), and airport surveillance detection equipment (ASDE). The Mode S project modernizes the secondary surveillance radar. It is co-located with ASR and long-range radars and operates with equipped aircraft to provide information on aircraft identity and altitude. The modernization of tube-type ASR, long-range radar, and provision of Mode S data link form an integrated set of projects required to provide the quality surveillance data needed for the operation of the advanced automation system in area control facilities. Since conventional surveillance radar, designed for aircraft detection, detects weather poorly, the weather radar project is included in the set to improve weather detection. Additionally, the direction finder project modernizes that equipment used to locate aircraft outside of radar coverage.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
1. Air/Ground (A/G) Communications Equipment Modernization	1980	1987
2. Communications Facilities Consolidation/Network	1985	1992
3. VORTAC	1981	1992
4. Nondirectional Beacon (NDB) *	1987	1988
5. Global Positioning System (GPS) Monitors	1991	1991
6. Instrument Landing System (ILS)	1981	1990
7. Microwave Landing System (MLS)	1988	2001
8. Runway Visual Range (RVR)	1988	1994
9. Visual Navaids	1981	1992
10. Approach Lighting System Improvement Program (ALSIP)	1981	1992
11. Direction Finder (DF)	1982	1992
12. Mode S	1990	1995
13. Terminal Radar (ASR) Program	1988	1992
14. Airport Surface Detection Equipment (ASDE 3) Radar	1989	1991
15. Long-Range Radar Program	1987	1996
16. Weather Radar Program	1989	1995
17. LORAN C Systems	1988	1991
18. Terminal Doppler Weather Radar System	1993	1996

* Depot Delivery Dates

PROJECT SUMMARY

PROJECT 1: Air/Ground (A/G) Communications Equipment Modernization

Purpose: This project will replace obsolete tube transmitters and receivers with solid-state models capable of operating in a 25-kHz channel environment. The project also replaces old antennas with more effective designs that will enhance the A/G communications system and permit the use of lower transmitter output power.

Increases in the demand for communication services in air traffic control have generated a requirement for additional channels. This can only be accomplished in the frequency spectrum by decreasing the channel spacing to 25 kHz. The reduction of channel spacing to 25 kHz cannot be economically accomplished with the tube-type equipment. Conversion to solid-state equipment also provides cost-savings through reduction in maintenance manpower and power consumption.

Approach: The project was planned on a multiyear basis to be procured in three phases.

- Phase I – Replace en route A/G facilities.
- Phase II – Replace terminal A/G facilities.
- Phase III – Replace FSS A/G facilities.

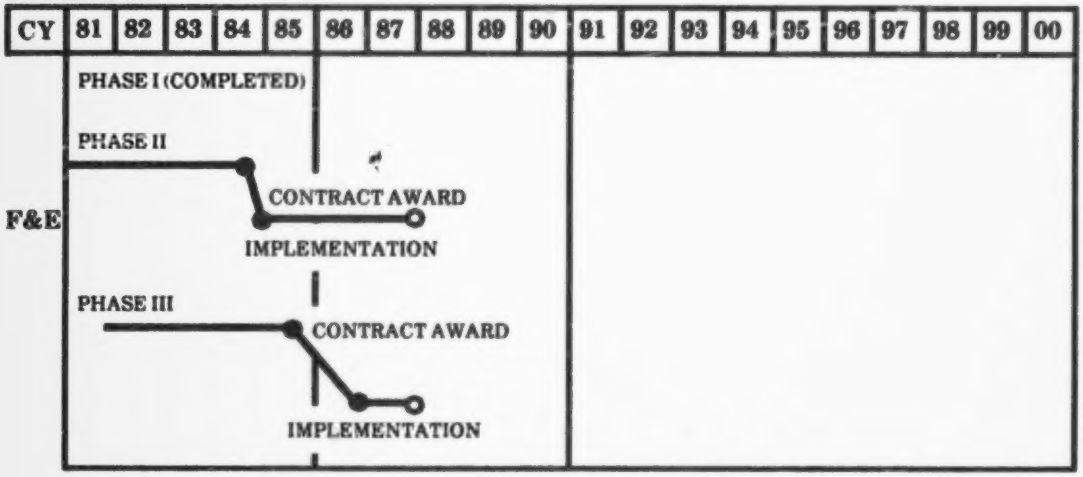
Tube-type equipment replaced by this project will not be relocated or installed at new sites. Current plans call for replacing multichannel tube-type equipment with dedicated single-channel transmitter/receivers for each operating frequency. This approach is generally the most cost effective and reliable course of action.

Products: The total acquisition will result in the following:

FY	Number of Trans/Rec	Antennas
81	3,700	2,800
82	2,400	4,400
83	3,100	8,900
84	4,400	9,000
85	1,500	1,000

Related Projects/Activities: This project, along with other FAA efforts for providing remote maintenance monitoring equipment and communication facility consolidation, contributes to FAA's program to modernize radio communication. Remote monitoring subsystems for air/ground communication facilities will be acquired under the Radio Control Equipment (RCE) project. Remote communications facilities will be modernized under the Remote Communication Facility/System project. NAS spectrum engineering will provide new frequency assignments as a result of the 25 kHz channel separation requirements.

SCHEDULE



PROJECT 2: Communications Facilities Consolidation /Network

Purpose: This project will reduce the cost of operating radio communications facilities. This project results in air/ground communication from larger, more cost-effective consolidated remote communications facilities (RCF) in lieu of the existing large number of facilities (approximately 2,700 remote transmitters/receivers (RTR), remote center air/ground communications facilities (RCAG), remote communications outlets (RCO), and backup emergency communications (BUEC)).

- The consolidation and relocation of remote communication facilities will result in the establishment of communication facilities which serve the combined needs of air traffic control and flight service station facilities.

- Consolidation of these facilities into FAA-owned facilities is one step in FAA's program to provide a modern solid-state remote-monitored radio communications network. These efforts result in cost-savings and cost-avoidance through reduced land leases, reduction in maintenance and maintenance travel, reduced power consumption (heating and air conditioning for separate buildings), and reduction in leased services.

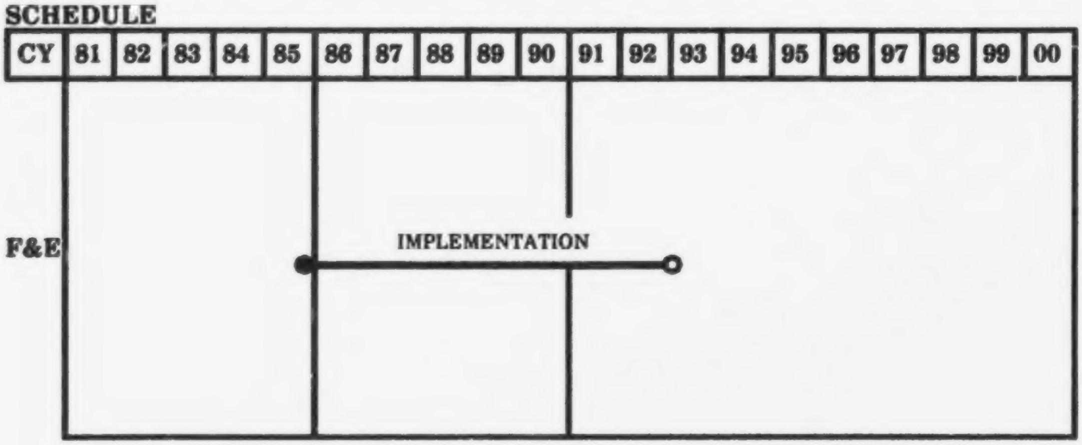
Approach: Multiple RTR facilities at many airports will be consolidated as solid-state receivers and transmitters are installed. FSS communications not already at VORTACs will be consolidated at selected FAA-owned facilities. New and existing RCAGs will be co-located with other FAA-owned facilities. A frequency interference study is required prior to combining large numbers of transmitters and receivers. Development of receiver multicouplers and transmitter combiners is needed to reduce the number of antennas required, especially at VORTACs. This project also includes interference suppression devices and ancillary devices such as multicouplers, combiners, filters, and cavities. Maximum facility size has been estimated to be 24 frequencies.

A national air/ground communications network plan has been completed and will be updated periodically. Air/ground communications coverage will be provided down to 2,000 feet above ground level in all areas except where there is little air traffic activity. In certain specifically defined areas, coverage will be required to or approaching ground level.

Products: Although the communications networking plan has been completed, each region must complete benefits/cost analysis for proposed consolidations. For planning purposes, 2100 facilities is being used as the estimate to be achieved by the year 2000.

Related Projects/Activities: Solid-state transmitter/receiver and radio control equipment must be implemented to avoid relocation of obsolete equipment. The navaid, DF, and radar networking plans and the National Airspace Review are required to finalize facility topology. These consolidated facilities will include RMM capability for channels with radio control equipment installed. Electromagnetic compatibility (EMC) studies have been conducted and EMC guidelines have been developed for consolidated sites. This project will require interfacility communications service from the NICS. That service will be provided through the RML Replacement and Expansion project.

SCHEDULE



PROJECT 3: VORTAC

Purpose: Very high frequency omnidirectional ranges (VOR) with distance measuring equipment (DME) or tactical air navigation (TACAN) are en route air navigational and approach aids used by pilots to conduct safe and efficient flights and landings. This project forms a modern cost-effective national navigation network which provides required coverage through replacement, relocation, conversion, and establishment of VORTAC and VOR/DME.

- Replacements. During FY-78 to FY-83, the FAA budgeted to replace all existing vacuum-tube VOR and VORTAC systems with modern solid-state equipment. This new equipment has been delivered and installations are nearly complete. DMEs at 40 VOR/DME sites will be replaced in FY-91 with new RMM compatible DMEs. The units removed will then be redeployed at ILS sites. DME will be added at 46 VOR-only sites.

- Relocations. It is necessary to relocate facilities due to site suitability, route structure changes, or real estate considerations.

- Conversions. Doppler VORs solve unique siting problems and allow coverage requirements to be met with fewer VORs.

- Establishments assume operational and maintenance responsibility for non-Federal facilities. Operational requirements that arise in various geographic areas necessitate that FAA increase system capacity by implementing VHF navigational aid service. As many as 70 VOR/DME sites may be established to meet identified requirements.

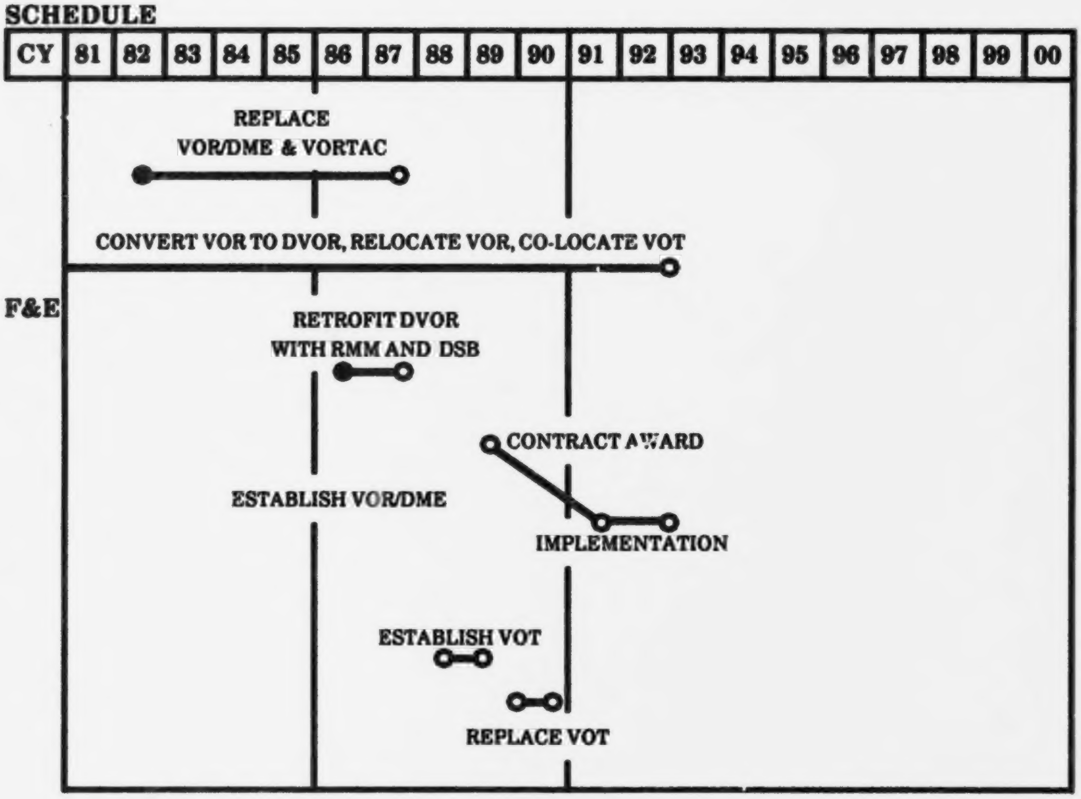
Approach: Complete the replacement of all existing equipment with standard solid-state systems which include remote monitoring and control capability, and add DME to all VOR only facilities. A national network plan has been developed to redistribute VORs to meet operational requirements. Tube-type VOR test (VOT) equipment will be replaced with solid-state equipment and co-located with other facilities where possible.

Products:

	1981-1985 Quantity	1986-1990 Quantity	1991-2000 Quantity
Replace VORTAC	725		
Replace VOR/DME	145		
Replace VOR	80		
Establish VOR/DME			70
Establish DME at VOR			46
Replace DME at VOR			40
Reinstall DME at ILS			40
Convert VOR to DSB DVOR		40	
Retrofit DVOR with RMM & DSB		50	
Establish VOT		35	
Replace VOT		77	

Related Projects/Activities: Remote communications facilities (RCF), DF, LORAN C monitors, and AWOS facilities will be co-located at many VORTACs (after conversion to solid state). RMM will be required to accommodate all combined facilities. The locations of combined facilities will depend on network studies.

Frequency and spectrum engineering is required to provide frequency protection for the proposed networking concept and provide non-interfering frequencies for VOR/DME/VOT locations. In addition, the plan to co-locate navigational, surveillance, and communication facilities requires frequency engineering studies and guidelines. This project will require interfacility communications service from NICS. That service will be provided through the RML Replacement and Expansion project. The voice channel of the VOR will be used to broadcast HIWAS data and may be used for AWOS and ATIS data.



PROJECT 4: Nondirectional Beacon (NDB)

Purpose: The nondirectional beacon (NDB) is a low/medium frequency facility that transmits omnidirectional signals, whereby the aircraft pilot can navigate by determining the bearing from or to the station. NDBs are used for standard instrument approach procedures (SIAP) to supplement other navaids which support SIAPs and for en route navigation. Additional facilities are required for operational purposes; obsolete facilities need to be replaced; and some existing facilities require relocation.

Existing tube-type systems are manpower-intensive and very costly to support. New systems will provide savings in energy consumption, improve reliability/availability, and reduce site visits. At selected sites, NDBs with RMM capability will be installed.

Approach: Establish and replace NDBs and add RMM as appropriate. The establishment of additional facilities on a non-interfering basis, within a limited radio frequency band, may require that individual site bandwidths be narrowed. This will eliminate the NDB's voice feature.

Products:

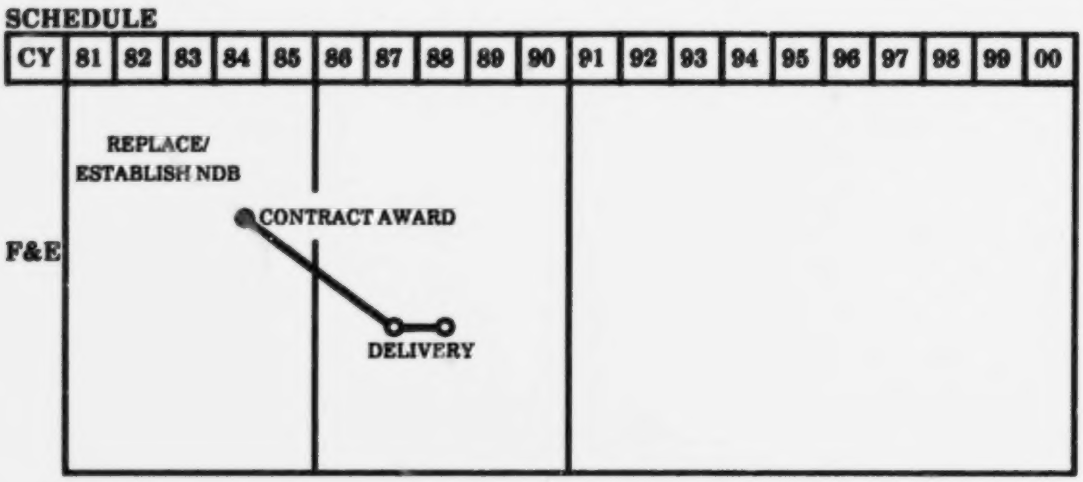
TOTALS BY TARGET YEAR

	1981	1985	1990	2000
NDB (H & COMLO)	600	634	682	682

The following assumptions have been made in developing quantities to be procured:

- There will be a reduction in the cost of NDB operational systems.
- Both terminal and en route NDBs are included.

Related Projects/Activities: Locations and total numbers of NDB facilities will depend on network studies. Frequency and spectrum management aspects of co-located facilities must be studied. This project will require interfacility communications service from the NICS. That service will be provided through the Data Multiplexing project. Selected NDBs will be monitored at the maintenance control centers via the remote maintenance monitoring network.



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PROJECT 5: Global Positioning System (GPS) Monitors

Purpose: VOR/DME is the international standard for civil air navigation and will remain into the next century. Other navigation systems that provide service in the NAS in conjunction with VOR/DME are termed supplemental systems. Subsequent to GPS becoming operational, it will serve as a supplemental system for civil aviation in addition to its primary role as a U.S. military positioning system.

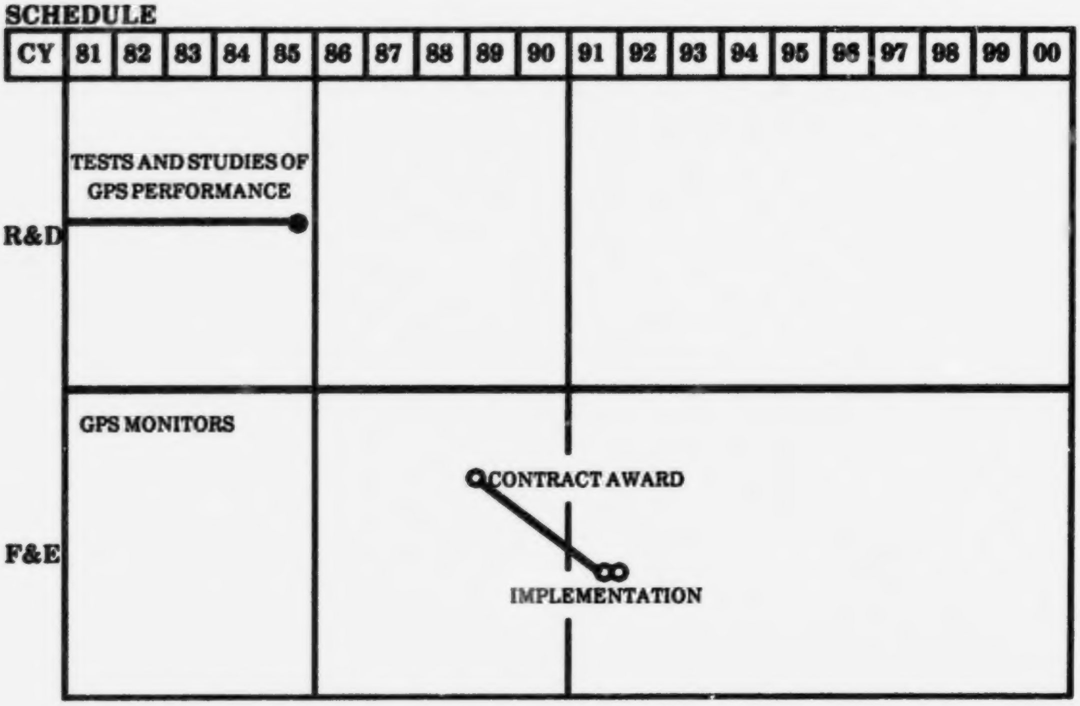
Use of any navigation aid in the NAS by civil aviation requires FAA approval. Beyond the approval of avionics performance, it is necessary for the FAA to monitor GPS satellite signals in order to be immediately aware of the operational status of the total GPS navigation system. Monitor data will be used to inform pilots and air traffic personnel of the status of GPS.

Approach: A study of GPS performance and monitoring techniques was completed in 1985. An analysis was conducted to determine the appropriate numbers and locations of monitors necessary to alert pilots and air traffic control personnel of degradation of GPS navigational data.

Products: Four GPS monitors will be deployed in 1991.

Related Projects/Activities: This project will require interfacility communications service from the NICS.

SCHEDULE



PROJECT 6: Instrument Landing System (ILS)

Purpose: This project will provide for the establishment and upgrading of conventional instrument landing systems (ILS). Systems to be established are those which previously qualified under the Airway Planning Standard Number One (APS No. 1), those in other special programs such as the Commuter Airport Program, and those at locations specifically named by Congress. Airports with 2,500 or more annual instrument approaches by certificated route air carrier aircraft are eligible for Category II ILS facilities which permit landing operations with 100-foot decision height and 1,200 feet runway visual range.

Additionally, FAA plans for implementation of the microwave landing system (MLS) include an extensive transition period into the 1990s. During this period, the present conventional instrument landing systems must continue in operation to provide time for the aviation community to equip their aircraft with the required avionics and to allow for MLS ground equipment procurement and deployment. To avoid increasingly difficult and costly support problems, it is planned, in the interim period, to replace tube-type components of approximately 263 instrument landing systems.

Approach:

- Category I Establishment. New ILS equipment establishment will be kept to a minimum in line with FAA's plans for early implementation of MLS.

- Replacement. Tube-type ILS equipment will be replaced at those airports which are not scheduled to receive MLS equipment prior to 1990. A portion of these replacements is being accomplished using equipment or funds recovered from ILS establishment projects that were reprogrammed to MLS. A portion is being provided by a modification to the ongoing ILS contract and the balance is to be provided under the contract for ILS components.

- Category II Establishment. There were two Category II locations in the FY-85 budget which received their equipment from the new ILS contract. New Category II sites required the concurrent installation of an ALSF 2 system and additional runway visual range systems to provide horizontal visibility at touchdown, midpoint, and rollout portions of the runway. There are no plans to replace remaining Category II facilities or establish new facilities at this time.

Products: (Funded and being installed)

	FY-86 and Prior
● Establish Category I.	
– Full systems.	22
– Partial (localizer).	3
– Glide slope.	10
● Replace Tube Type.	
– Localizer and glide slope.	193
– Localizer or glide slope.	70
● Establish Category II.	
– Full systems.	2

Related Projects/Activities: Qualifying solid-state ILS systems will be retrofitted with remote maintenance monitoring. Qualifying facilities will receive medium-intensity approach lighting systems with runway alignment indicator lights (MALSR) and/or runway visual range (RVR). NAS spectrum engineering support is required for ILS establishment to ensure interference-free operation.

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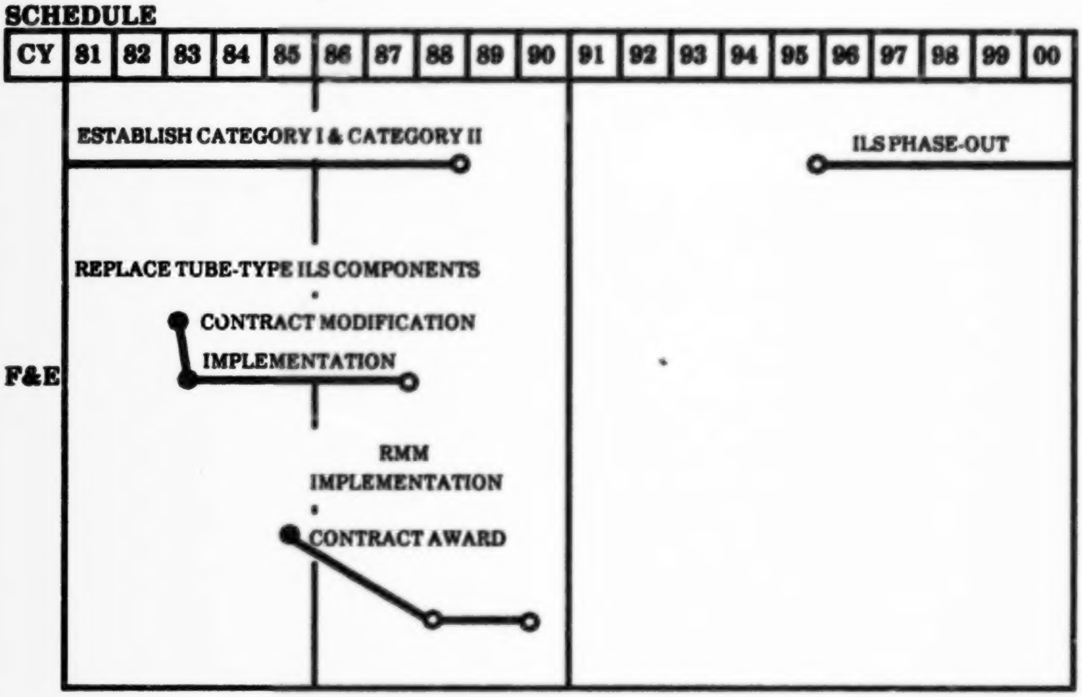
SCHEDULE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ESTABLISH CATEGORY I & CATEGORY II
ILS PHASE-OUT
REPLACE TUBE-TYPE ILS COMPONENTS
CONTRACT MODIFICATION
IMPLEMENTATION
F&E
RMM
IMPLEMENTATION
CONTRACT AWARD

PROJECT 7: Microwave Landing System (MLS)

Purpose: MLS has been adopted by the International Civil Aviation Organization (ICAO) as a world standard to replace ILS. It provides precision guidance to satisfy the full range of operational requirements, both civil and military, to all types of aircraft in all categories of landings. It overcomes the inherent limitations of existing ILSs. Radiated signals are minimally affected by surrounding terrain, structures, and weather effects, thereby providing low-cost installation in all airport environments. The MLS with RMM capabilities will reduce the maintenance manpower requirements associated with ILS. The MLS will eventually provide multiple-curved and segmented approaches and selectable glide slope angles. An integral part of MLS is a precision distance measuring equipment (DME/P) with 100-foot accuracy. The DME/P will provide service to conventional DME users.

Approach: In 1984 a multiyear contract was awarded to procure initial quantities of production quality systems. Funding was provided for 15 systems each in FY-82 and FY-83; 28 systems in FY-84 (2 for training and test bed); and 60 systems each in FY-85 and FY-86. A second contract is anticipated to be awarded in FY-88 for up to 500 FAA systems implemented through FY-96. A third contract may be awarded in FY-93 to cover the balance of the 1,250 FAA systems required.

The MLS program includes, at most locations, a medium-intensity approach lighting system with runway alignment indicator lights (MALSR). MALSRs installed to serve ILS will not be duplicated to serve a subsequent MLS installation on the same runway.

The operational service test and evaluation program (STEP) has been completed using prototype equipment at several typical locations. Users have participated with airborne receivers provided by the Government. Using results from STEP, operational procedures, and obstacle clearance/critical area criteria are being developed to support the implementation process. These include unique MLS capabilities, such as curved and segmented approaches, missed approaches and departure guidance, as well as conventional approaches.

Analyses are being conducted to support ICAO standards for such items as DME/P auxiliary data, operational criteria and procedures. Also, system specifications will be expanded to incorporate enhanced MLS capabilities (growth features such as 360 degree azimuth).

Products: 1,250 MLSs will be procured. In addition, DOD plans to procure 194 systems from 1988 through 1992, and 211 systems in the outyears.

Related Projects/Activities: RVRs will be installed with MLSs where weather conditions meet requirements in Airway Planning Standard Number One (APS No. 1). The ILSs will be decommissioned as sufficient MLSs are implemented in accordance with a transition plan that will minimize the impact on the user. Some MLSs will not have MALSRs due to obstructions to the plane of the MALSR light or excessive installation costs due to terrain.

Frequency and spectrum engineering is required for MLS establishment.

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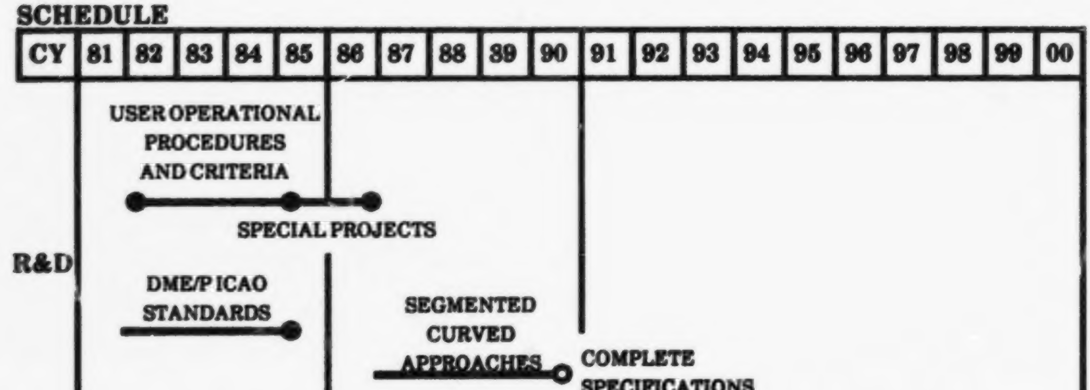

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PROJECT 8: Runway Visual Range (RVR)

Purpose: This project establishes and modernizes existing runway visual range (RVR) systems on qualifying Category I, II, and III ILS and MLS runways.

There are 425 RVR systems of various generations currently in service in the NAS. Approximately 10 percent of these consist of Runway Visibility Value (RVV) equipment which requires manual computation by the air traffic controller to arrive at RVR data and does not take into account such variables as runway lighting intensity and ambient light conditions.

Approach: A new RVR System, employing advanced technology, will provide an inherent capability to satisfy CAT I thru CAT IIIc requirements. The new RVR System will be fielded to replace all existing RVV and RVR equipments which are maintenance intensive and employ outdated technology. The project will also provide new generation equipment for establishment at qualifying facilities.

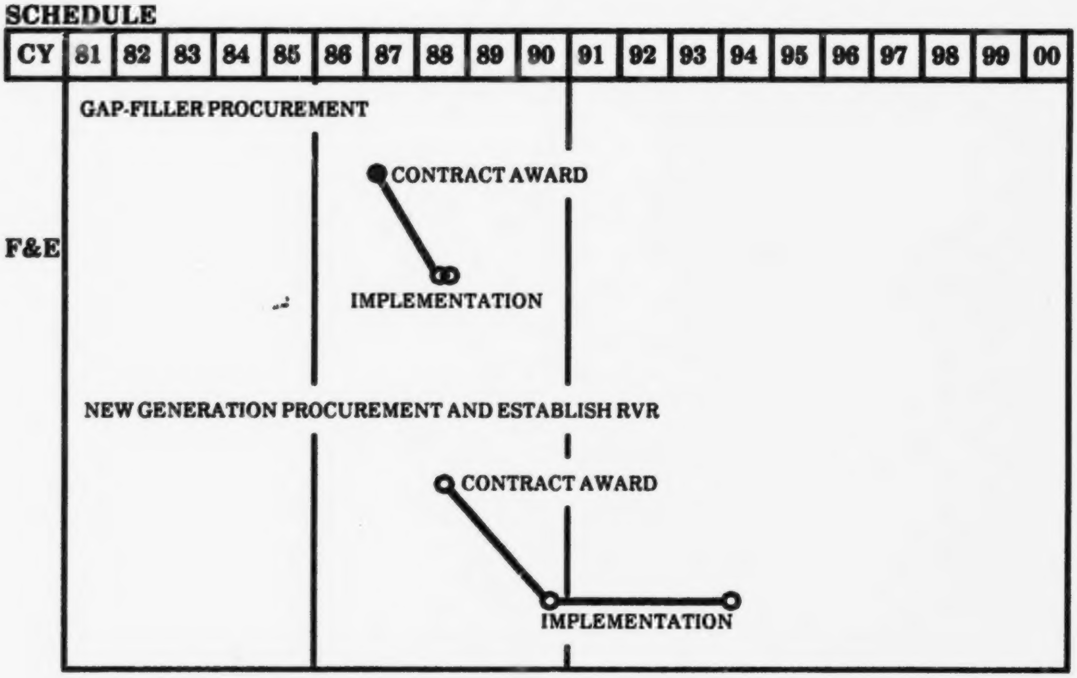
In light of the time associated with delivery of new generation RVR equipment, an RVR gap filler project will also be implemented. The RVR gap filler project will provide RVR equipment which is identical to the latest generation equipment now in the field, and will satisfy urgent regionally identified requirements, pending receipt of new generation RVR equipment.

Products:

• Replace existing systems	247
• Establish new locations	97
• Gap Filler Establishment and Replacement	11

Related Projects/Activities: Instrument Landing Systems and Microwave Landing Systems are related projects. All Category II and III facilities require RVR; however, weather conditions and facility operations must meet APS No. 1 criteria if RVR is to be installed on Category I ILS or MLS runways.

SCHEDULE



PROJECT 9: Visual Navaids

Purpose: This is an ongoing multiyear program to provide safety-related facilities and enhancements at airports. The facilities to be provided are: medium-intensity approach lighting system with runway alignment indicator lights (MALSR), runway-end identification lights (REIL), visual approach slope indicator (VASI) or precision approach path indicator (PAPI), and omnidirectional approach lighting system (ODALS).

This program also includes the replacement or establishment of remote radio controls for visual aids to meet the operational requirements of air traffic controllers and removing complex coding requirements. The new system will permit single-button control of each visual-aid function.

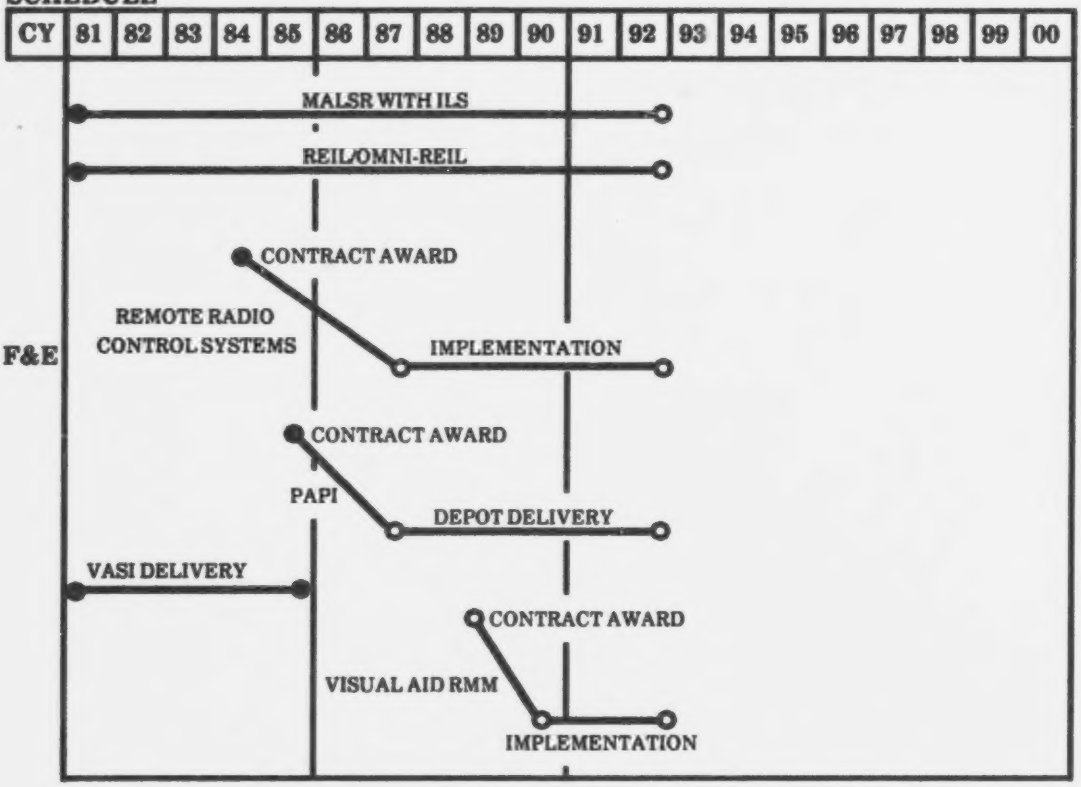
The role of aviation has grown steadily in the past, and the rate of growth is expected to continue in the future. This program is based, in part, on the essential service concept expressed in the Airline Deregulation Act of 1978. It provides an equivalent level of safety to all commercially served airports and general aviation airports.

Approach: Installation is to be accomplished by regions. Washington headquarters will furnish standards and equipment. Visual and electronic navigational aid projects will be completed in conjunction with other related projects where possible. MALSR lights installed to serve an ILS will not be duplicated for a subsequent MLS installation on the same runway.

Products: Quantities vary from year to year depending upon the urgency of the requirement, validation of requirements, and availability of funds. The radio control retrofit program will involve 1,348 airports having a total of 3,032 visual aids.

Related Projects/Activities: This project, when combined with the Approach Lighting System Improvement Program project, will totally modernize the currently installed airport lighting systems. The modernization will result in improved safety and increased energy efficiency for both the approach and guidance lighting systems. Spectrum engineering is required for all radio control retrofits. The Airport Telecommunications and Airport Power Cable Loop Systems are also related projects.

SCHEDULE



PROJECT 10: Approach Lighting System Improvement Program (ALSIP)

Purpose: This is a multiyear program to retrofit existing airport runway approach lighting systems with low-impact resistant approach light supports and other improvements. The intent is to bring approach lighting systems, built before 1975, up to current standards for new installations.

Replacement of the existing rigid tower structures with light-weight and low-impact resistant structures that collapse or break apart upon impact will reduce damage to an aircraft should it strike an approach light tower structure during departure or landing. This should help reduce the severity of approach and landing accidents. This effort was mandated by FAA Order 1811.4, System Requirements Statement/Acquisition Authorization for the Approach Lighting System Program, signed by the Administrator on June 12, 1979, in response to an NTSB recommendation. The program will also result in a significant reduction in FAA energy consumption and the replacement of outdated and obsolete equipment.

Federal air regulations authorize a pilot to descend below the published minimum descent altitude or decision height, provided that visual references (e.g., approach lights, threshold lights) for the intended runway are distinguishable. The installation of threshold light bars as part of the existing medium-intensity approach light system with runway alignment indicator lights (MALSR) will provide a visual reference to the runway threshold and make the present system more effective in low-visibility conditions. The modification will enhance safety and comply with ICAO minimum requirements.

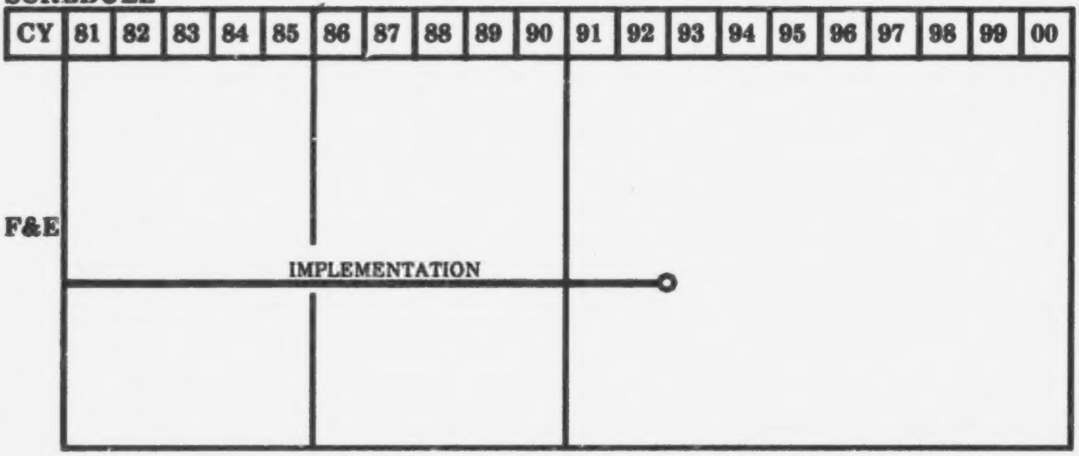
Approach: In the interest of energy conservation, high-intensity approach lighting systems with sequence flashers, Categories II and III runway configurations, are to be switchable to the simplified short-approach lighting system with sequence flashers when visibility conditions permit. The simplified short-approach lighting system configuration uses less than half the lights of the full high-intensity approach lighting system. In addition, the program will retrofit nonfrangible high-intensity approach lighting system on Category I runways with frangible medium-intensity approach lighting system with sequence flashers. When the program is fully implemented, energy consumption of these systems will have been reduced by 60 percent over FY-76 base-year requirements; and approach lighting systems will be of two standard types -- ALSF 2 and MALSR

Products:

- 205 SSALF, SSALR, and ALSF 1 systems will be converted to MALSR.
- 68 ALSF 2s will be provided with low-impact resistant structures and the capability to switch to SSALR configuration.
- 182 MALSRs will be placed on low-impact resistant structures.
- 384 existing MALSRs will be provided with threshold lights.

Related Projects/Activities: This project, when combined with the Visual Navaids project, will totally modernize the currently installed airport lighting systems. The modernization will result in improved safety and increased energy efficiency for both the approach light and guidance lighting systems.

SCHEDULE



PROJECT 11: Direction Finder (DF)

Purpose: The purpose of this project is to upgrade existing direction finder (DF) systems with solid-state equipment and to establish sites for additional coverage. Additionally, new indicators will be established within selected FSS or AFSS control facilities to increase operational efficiency.

The replacement of the existing tube-type DF system with solid-state equipment will result in cost savings and cost avoidance by reducing power consumption and maintenance requirements.

Approach: The existing tube-type DF equipment will be replaced with new solid-state equipment which has remote maintenance monitoring, control, and certification capabilities.

In areas where present DF equipment does not provide complete coverage, new sites will be established and co-located with existing FAA facilities (such as VORTAC). New displays and processing equipment will be located within AFSS facilities interfacing with both existing and new solid-state of receiver sites. Multiple receiver sites will be networked to the display equipment.

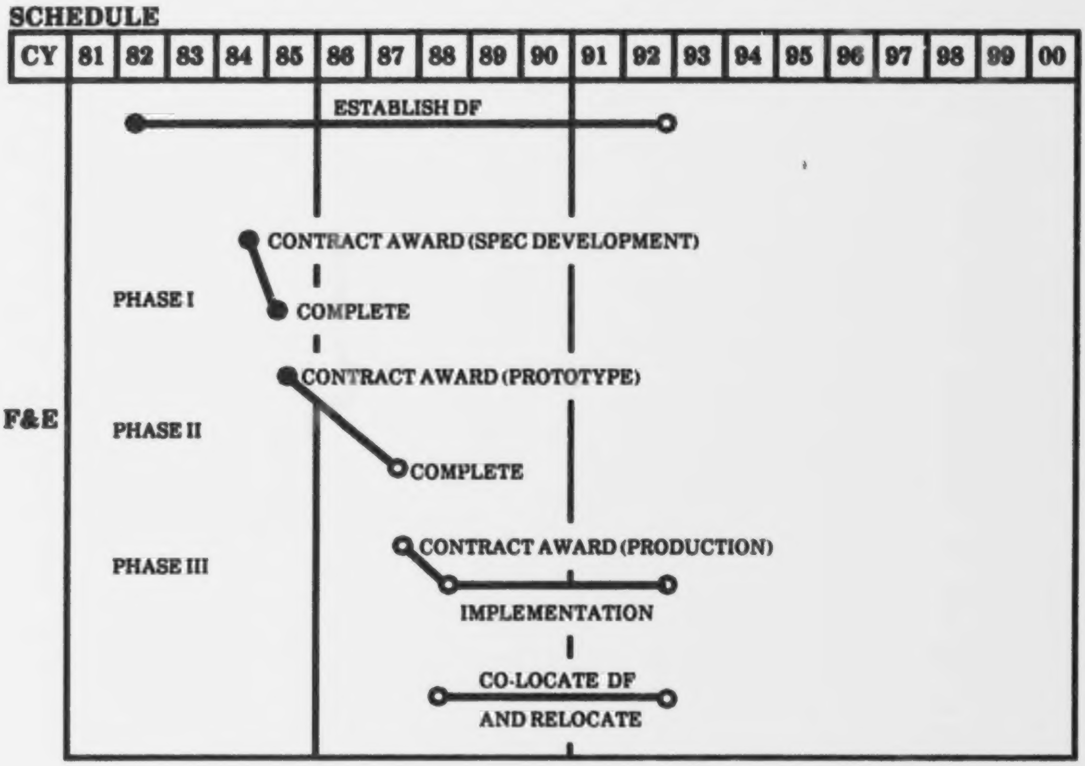
The regional network studies indicate that the total number of DFs will be 369 by the year 1992.

Products:	1981-1985	1986-1990	1991-2000
Establish DF	125	20	49
Replace DF		145	30
Co-locate DF			(as required)

TOTALS BY TARGET YEAR

	1981	1985	1990	2000
DF	175	245	280	369

Related Projects/Activities: DFs will be co-located with VORTAC and communications equipment, depending on the results of the network plans and facility consolidation activity. A co-location study will be conducted at the FAA Technical Center to develop EMC guidelines. FSAS is also a related project.



PROJECT 12: Mode S

Purpose: This project will improve the surveillance capability of the air traffic control radar beacon system (ATCRBS). Mode S provides more accurate positional information and minimizes interference. This is accomplished by discrete interrogation of each aircraft and improved processing of aircraft replies.

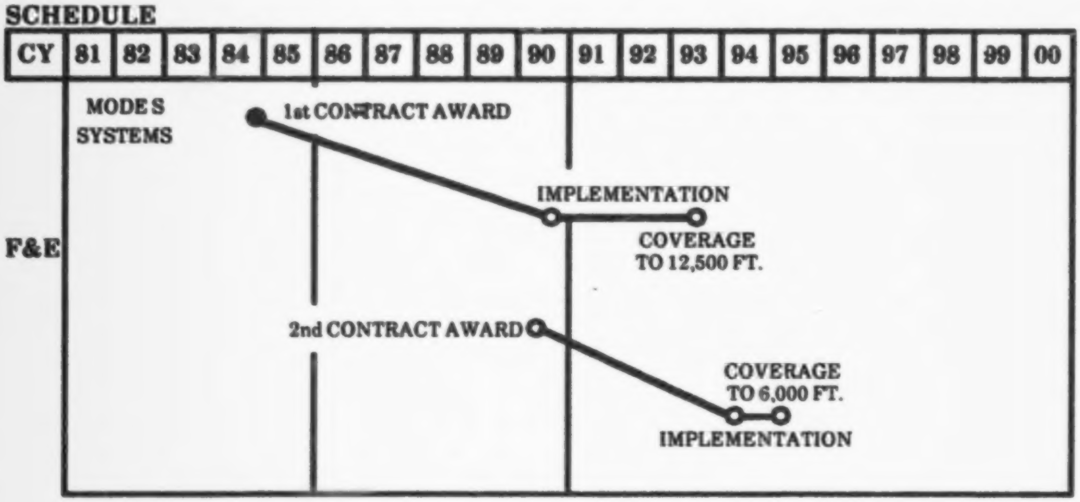
In addition, Mode S provides the medium for a digital data link which will be used to exchange information between the aircraft and various ATC functions and weather data bases.

Approach: Required Mode S systems will be procured using multiple contracts. The first contract for 137 systems will provide coverage down to the ground at 108 terminals and down to 12,500 feet above mean sea level (MSL) in other areas. The second contract for an additional 60 systems will extend this coverage down to 6,000 feet msl or minimum instrument flight rules en route altitude and above, whichever is higher. The systems are designed to be remote maintenance monitored and unmanned. Existing ATCRBS antennas not already capable of improved azimuth resolution will be replaced and/or additional antennas procured where increased data rates are required.

Products:

- 197 Mode S systems at a maximum production capability of 48 per year.
- Specification for Mode S antenna for long-range radars.
- 55 Mode S back-to-back monopulse antennas for en route surveillance sites.

Related Projects/Activities: The traffic alert and collision avoidance system (TCAS) utilizes Mode S data formats and frequencies. Mode S will be an RMM system. AAS software (AERA) will use Mode S data link for transmitting data from ACFs to aircraft. This project will require telecommunications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing. The WCP will use the Mode S data link to transmit weather data to aircraft. Most terminal and en route surveillance radars will be co-located with Mode S and share a digital interface with the ATC automation system. Spectrum Engineering is required to assure interference-free operation.



PROJECT 13: Terminal Radar (ASR) Program

Purpose: This project will continue to provide economical radar service at airports with air traffic densities high enough to justify the service and to upgrade the highest density airports with the latest state-of-the-art equipment.

Replacement of the ASR 4/5/6 is necessary because of the decreasing availability of spare parts and the high-maintenance workload. Repair parts availability for the ASR 4/5/6 radars will be critical by 1989.

Approach: Three separate activities have been combined to form this program.

- Replacement of 96 ASR 4/5/6 vacuum-tube radars with ASR 7/8/9 (leapfrog 16 ASR 7s to ASR 4/5/6 sites, leapfrog 40 ASR 8s to ASR 4/5/6, and install 40 ASR 9s at ASR 4/5/6 sites).
- Procurement of ASR 9 systems to provide radar service at airports where the air traffic volume increases to a level requiring the coverage.
- Relocation of existing solid-state radars (ASR 7/8) where necessary due to new construction interfering with required radar coverage or to changes in air traffic volume.

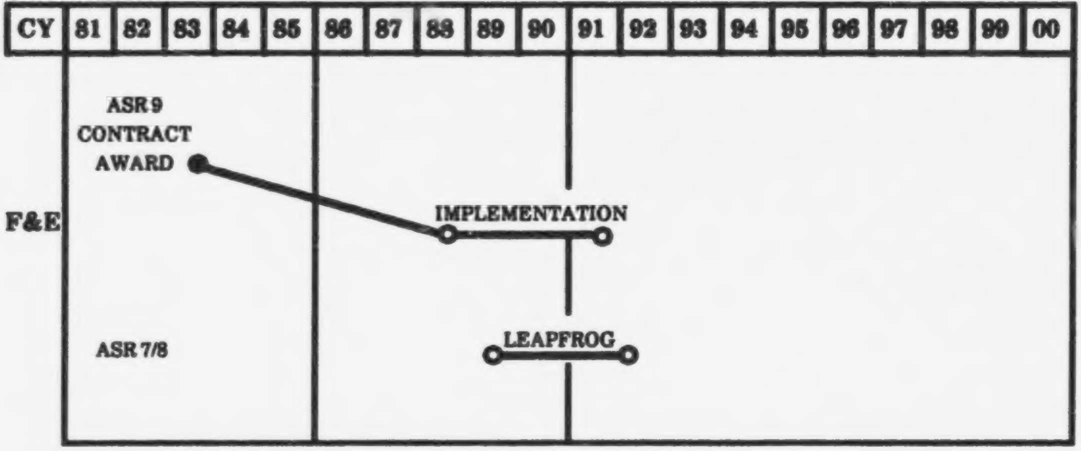
Data from ASR 9 radars will be remoted in digital format only. At the indicator site, the data will be available in digital and analog format.

Products:

- Replace 96 radars.
- Establish the minimum number of additional radars.
- Leapfrog 56 radars.
- Raise antennas where required.
- Remote data from some terminal radars based on coverage requirements that will exist prior to ACF implementation.

Related Projects/Activities: ASR 9 installations are planned to precede Mode S installations and must be coordinated. Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for pulse repetition frequency (prf) and frequency. ARTS IIA software changes will be required to interface with the ASR 9. Changes to ARTS IIIA software will not be required to accept ASR 9 digital data. This program will require interfacility communications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing.

SCHEDULE



PROJECT 14: Airport Surface Detection Equipment (ASDE 3) Radar

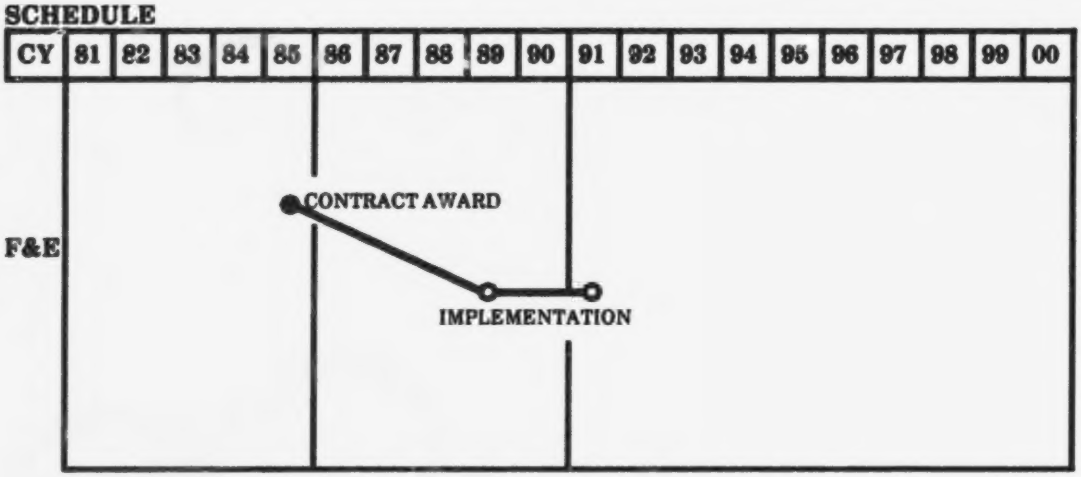
Purpose: The ASDE equipment will provide surveillance of aircraft and airport service vehicles on the airport surface. At high-activity airports, radar monitoring of airport surface operations (ground movements of aircraft and other supporting vehicles) is required to maintain aircraft separation and provide an effective and expeditious means of directing and moving surface traffic. This is especially important during periods of low visibility such as rain, fog, and night operations.

Approach: A specification has been developed which details a ground surveillance radar that will map the airport complex and identify aircraft or service equipment locations and movement. A contract was awarded in 1985.

The ASDE antenna may be located on top of the airport traffic control tower (ATCT) which may require some minor structural modifications. New installations may require structural modifications to the existing ATCT or possibly a separate remote tower.

Products: Deliveries are planned starting in calendar year 1989 with the last system delivery in 1991. Current requirement is for the establishment of 17 systems (includes FAA Academy) and for the replacement of 13 systems (12 ASDE 2s and 1 interim).

Related Projects/Activities: ASDE 3s will be remote maintenance monitored. Frequency and spectrum engineering is involved with the ASDE 3 implementation.



PROJECT 15: Long-Range Radar Program

Purpose: This project will provide a national surveillance network and replace, upgrade, or decommission systems requiring excessive maintenance and periodic visits.

It is essential that accurate and timely data on the presence and movements of aircraft transiting the en route ATC environment be continuously available to the en route ATC system so that maximum use can be safely afforded to all users of the airspace. This data can be made available by radar surveillance information.

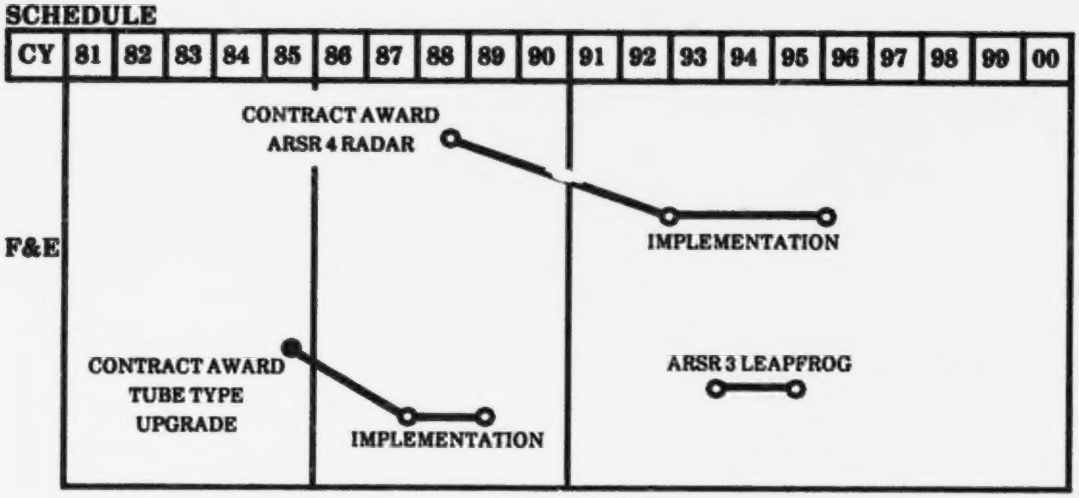
This replacement/upgrade program will significantly reduce maintenance workload and logistics costs, as well as resolve problems relating to nonavailability of spare parts for the existing old radars.

Approach: Replace selected portions of vacuum-tube radars with solid-state devices. Repair and refurbish other portions and improve tolerance to power fluctuations. Provide limited remote control. These steps are necessary to extend the usable life of the vacuum tube-type radars until the national network can be implemented. RMM will be provided for all ARSR 3 facilities. Expand the joint use of military radars to supplement existing coverage. Undertake a joint FAA/USAF procurement of ARSR 4 radars to replace all joint surveillance system (JSS) radars. Leapfrog ARSR 3 radars from JSS sites.

Products:

- 48 three-dimensional (ARSR 4) radars (includes 1 for field support and training).
- 12 ARSR 3 leapfrogs.
- Long range radar (LRR) relocations as required.
- 64 Upgraded en route tube-type radars.

Related Projects/Activities: Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for prf and frequency assignments. This program will require telecommunications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing will be remotely monitored from an MCC. Mode S is planned to be co-located and interfaced with the radars. The advanced automation system will receive target and beacon data from the radars.



PROJECT 16: Weather Radar Program

Purpose: This project will establish an aviation weather radar network that will provide accurate aviation weather products (precipitation reflectivity, wind velocity, and turbulence indicators). It will also furnish software algorithms to take advantage of the improved radar presentation of weather data.

Radar weather presentations available from today's systems provide limited data for air traffic control. Improved weather data will increase aviation safety and fuel efficiency. In addition to the improvements to be gained in today's system, future automated ATC functions, such as AERA and improved flow management, must have reliable and accurate weather data before maximum fuel efficiency and manpower productivity gains projected for these improvements can be realized.

Approach: This program consists of the definition, development, procurement, and installation of a new Doppler weather radar for en route applications. The long-range Doppler weather radar for en route applications, known as the next generation weather radar (NEXRAD), is being funded jointly by the Department of Commerce (60 percent), the Department of Defense (20 percent), and the FAA (20 percent).

The NEXRAD full production option will be exercised following procurement of the initial 10 units. The number of NEXRAD units are being determined by the Department of Commerce, Department of Defense, and the FAA. Interim display capability will be provided to support operation prior to CWP availability. A NEXRAD Communications Interface Unit (NCIU) Network will be provided to distribute weather products.

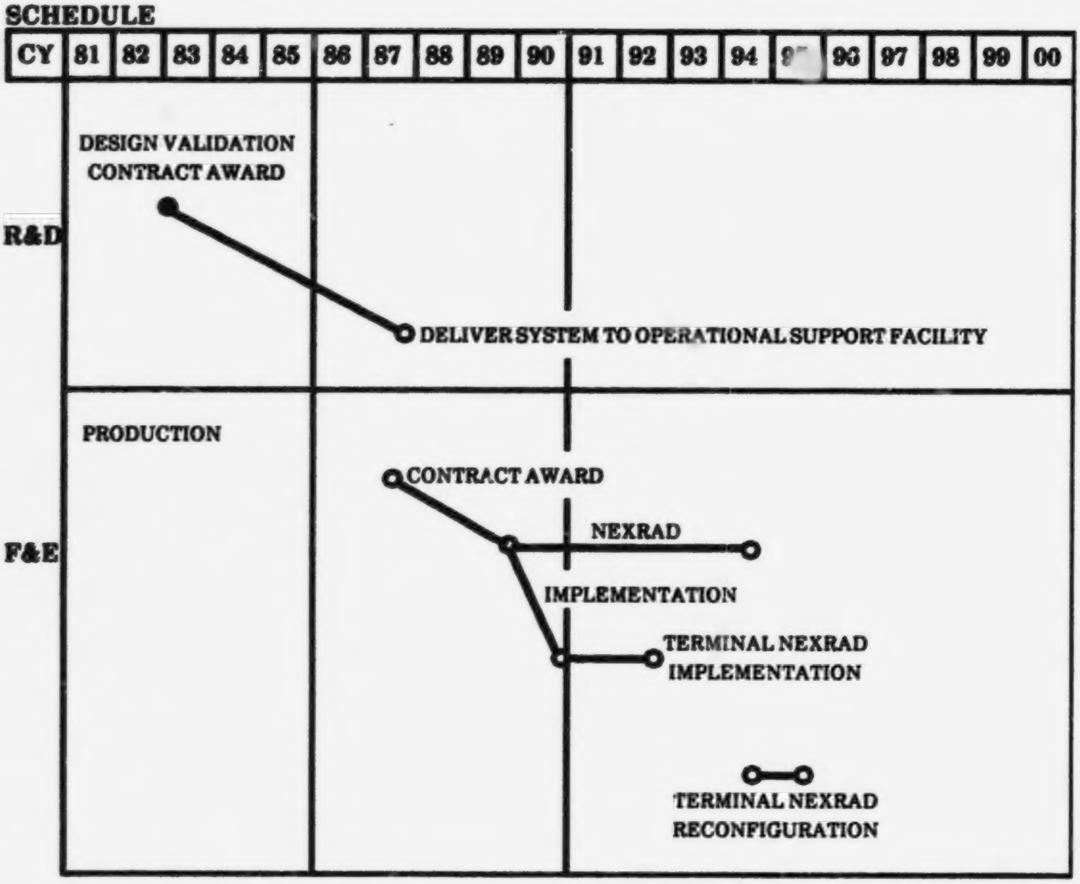
Products:

● NEXRAD	
– CONUS network (joint purchase with FAA, National Weather Service, and DOD)	113
– FAA	16
– DOD	44
– NWS support	2
– FAA support	1
● NEXRAD Communications Interface Unit (NCIU) Network	1
● Displays and processors for ARTCCs	23

Seventeen of the above NEXRAD units will be configured for terminal operation to provide early operational capability and experience with Doppler weather radar in the terminal area. After TDWRs are implemented sixteen of these units will be leapfrogged back to the NEXRAD network and the seventeenth unit will be used for FAA support.

Related Projects/Activities: CWP and leased communications are related activities. FAA non-CONUS NEXRADs will be remote maintenance monitored. Frequency and spectrum engineering is involved with the Terminal Radar, Long-Range Radar, and Weather Radar Programs since these systems compete for prf and frequency.

SCHEDULE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CONTRACT AWARD
NEXRAD
IMPLEMENTATION
TERMINAL NEXRAD IMPLEMENTATION
TERMINAL NEXRAD RECONFIGURATION

PROJECT 17: LORAN C Systems

Purpose: This project responds to a growing demand for LORAN C random navigation (area navigation) services by the aviation community, particularly in low-altitude, remote, and offshore areas not well served by VOR/DME equipment. LORAN C was originally developed for marine use and is presently being used for supplemental air navigation by over 40,000 users; primarily because of its low acquisition cost and area navigation coverage down to the surface. This is especially attractive for general aviation and rotorcraft operations. LORAN C is intended as an interim, supplemental radio navigation system for aviation use providing at least single-level coverage for en route and terminal IFR navigation for the contiguous United States. Additionally, nonprecision approaches will be supported where signal requirements are met.

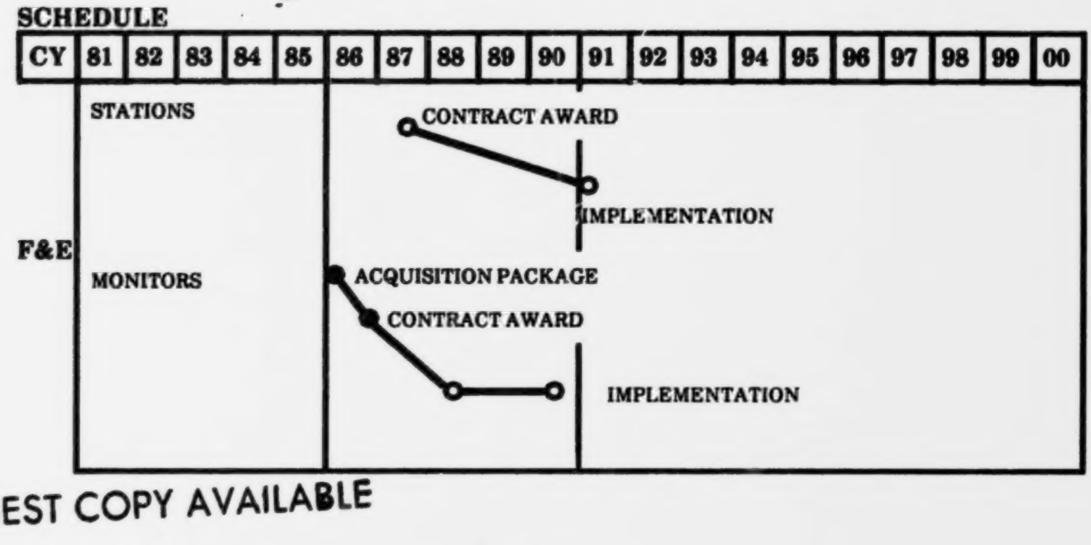
Approach: Studies have been completed to define the number and locations of LORAN C stations and signal monitors. Additional LORAN C stations will improve signal coverage for the Gulf of Mexico and fill the midcontinent coverage gap with at least single-level coverage. Signal monitors will provide correction values for nonprecision approaches.

The FAA will provide the procurement funds; and the U.S. Coast Guard will provide, operate, and maintain the transmitters under an interagency agreement. Deployment, operation, and maintenance of signal monitors will be an FAA responsibility.

Products: Four LORAN C stations will be required to complete single-level signal coverage for the 48 contiguous states. 102 monitors will be needed to support nonprecision approaches in existing signal coverage.

Related Projects/Activities: This project will require telecommunications service from the NICS.

SCHEDULE



PROJECT 18: Terminal Doppler Weather Radar System

Purpose: This project consists of the procurement and installation of a new Terminal Doppler Weather Radar System. The Terminal Doppler Weather Radar System will detect microbursts, wind shears, turbulence, tornadoes, and sustained wind shifts.

Microbursts are a weather phenomenon that consists of an intense downdraft that may occur in clear air or in precipitation areas and are particularly dangerous to aircraft landing or departing.

The Terminal Doppler Weather Radar scanning mode will be optimized for microburst/wind shear detection, and the radar will be located on or near the airport operating areas.

Approach: Trade studies that examined alternative designs, frequency comparisons and other design considerations have been completed by the two NEXRAD development contractors. Data from these studies will contribute toward TDWR specification development.

TDWR algorithms will be developed by the Government and furnished to the contractor. Data collected using the FAA Doppler weather support facility at Memphis and Huntsville will provide the primary basis for algorithm development. In addition to supporting the initial algorithm development, the facility will be used to evaluate enhancements for improved algorithms and to evaluate new algorithms on a continuing basis.

A competitive contract will be awarded for a contractor furnished turnkey system to include TDWR design, production, site preparation, installation and implementation at sites specified and acquired by the Government.

Experience gained in the development, design, production, installation and implementation of NEXRAD and Terminal NEXRAD, and associated studies will be used to the maximum extent applicable to TDWR. NEXRAD experience will be particularly significant in developing the TDWR algorithms and specification.

Products:

- Terminal Doppler Weather Radar Systems designed specifically for terminal operations will be procured for airports where safety considerations and use require this equipment.

Related Projects/Activities: AAS, NEXRAD, RMMS, and Spectrum Engineering are related projects. 17 NEXRAD units will be configured for terminal operation to provide early operational capability and experience with Doppler weather radar in the terminal area. After TDWRs are implemented 16 of the NEXRAD units will be leapfrogged back to the NEXRAD network and the 17th unit will be used for FAA support.

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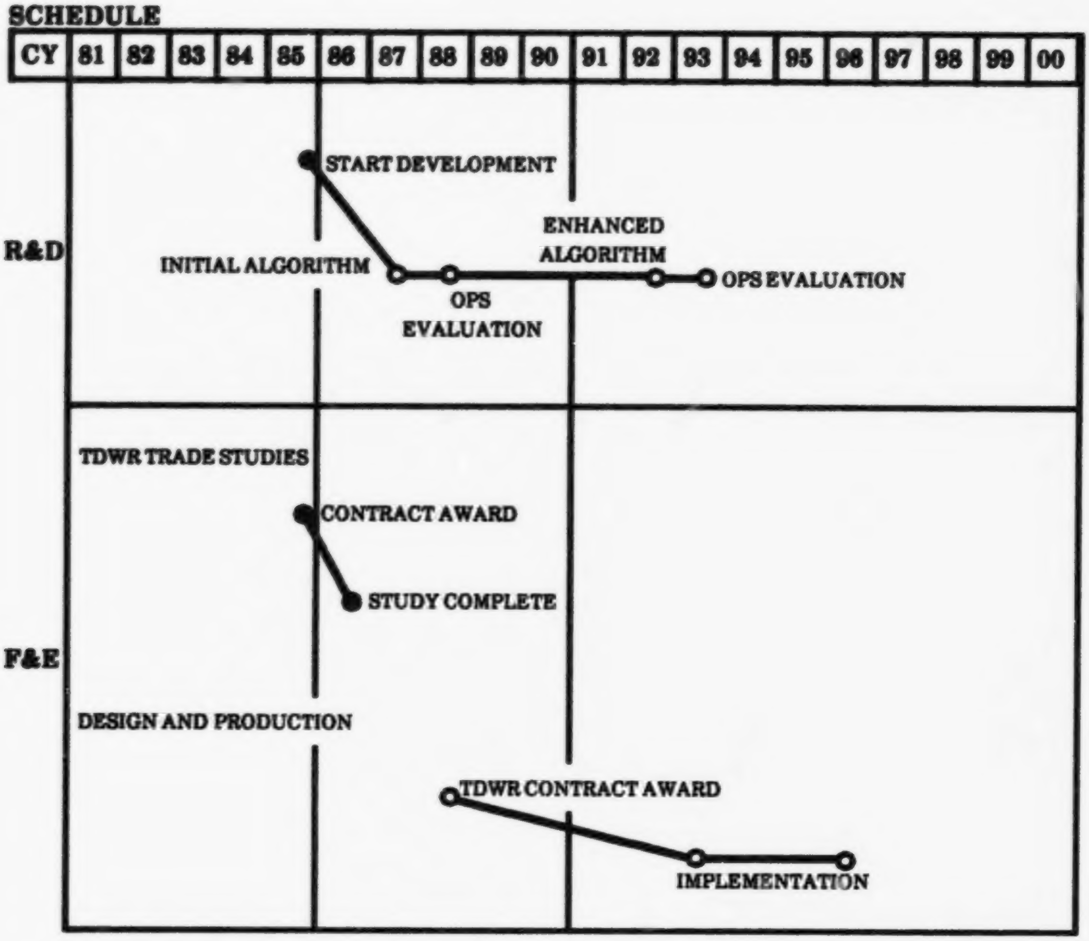
SCHEDULE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R&D
START DEVELOPMENT
INITIAL ALGORITHM
ENHANCED ALGORITHM
OPS EVALUATION
OPS EVALUATION
F&E
TDWR TRADE STUDIES
CONTRACT AWARD
STUDY COMPLETE
DESIGN AND PRODUCTION
TDWR CONTRACT AWARD
IMPLEMENTATION

CHAPTER V

INTERFACILITY COMMUNICATIONS SYSTEMS

INTERFACILITY COMMUNICATIONS SYSTEMS

Interfacility communications systems provide communications between FAA facilities, including major manned facilities, such as air route traffic control centers, airport traffic control towers, and smaller remote facilities, such as radar sites and ground-to-air radio sites.

Although most interfacility services used for both voice and data transmission are currently leased, some are FAA-owned. Most FAA-owned transmission media are radar microwave link (RML) equipment. RMLs are used to send en route radar information to appropriate air route traffic control centers. These links also are used for backup emergency communications (BUEC), ground-to-air receivers and transmitters, and other limited applications. These RMLs span about 16,000 miles.

The FAA also owns television microwave links (TML) which are used to remote radar information to tower BRITE displays at one or more satellite airports. They also can be used to remote data across an airport where it is too expensive to lay cable.

Most transmission media are leased, generally from local utility companies. Low-speed teletypewriter networks emanate from the Kansas City, Missouri, National Communications Center (NATCOM). These networks distribute a variety of aviation-related national and international information. Functions performed by these networks include distribution of flight plan information (Service B), weather information (Services A and C), and international messages (aeronautical fixed telecommunications network (AFTN)). Multiple terminals are co-located in the same facility. Network interconnections also are provided to other countries, the National Weather Service, and other users, such as airlines.

Most data circuits are low-speed (150 bits-per-second or less) subvoice-grade lines. Little interoperability exists on these circuits. Medium-speed lines (2400 bits-per-second) are used to connect newer equipment, such as computers. Very few high-speed circuits exist.

Voice circuits generally are leased, private lines between major facilities or between major facilities and remote facilities. In addition to voice applications, they are used for monitoring and control of transmitters, receivers, and navigational aids.

THE NEW APPROACH

The current interfacility system has evolved piece by piece as requirements dictated. Circuit costs were low, and the ability to provide services was generally limited to public utility communications companies. Over the years, however, common carrier telecommunications rates have escalated and are expected to continue to do so. Recently, competition has emerged in almost all telecommunications areas. Opportunities are now available for the FAA to take a systems approach to its interfacility communication needs and to develop a network which will provide greater reliability through alternate routing capabilities, flexibility, and growth potential, while constraining operating costs.

The NAS interfacility communications system (NICS) will be established to combine and integrate communications functions into one network. NICS will provide voice and data communications interconnectivity between facilities and sites within the NAS, intrafacility communications, and access to other systems which are external to the NAS (e.g., automatic voice switching network (AUTOVON)). NICS will support other NAS elements by providing voice and data services in three functional areas: (1) transmission, (2) switching, and (3) monitor and control. This new approach will result in better and expanded service to air traffic and other users while controlling cost.

The basic approach is to establish, over the next 5-8 years, a versatile communications utility which can provide the necessary variety of voice and data transmission and switching systems for all other systems in this Plan. Because communications are essential to the operation of these systems, this utility must evolve and become operational before the systems it serves. Services required include pure transmission of both voice and data (between major facilities and remote facilities) and voice and data switching services primarily between major facilities. Transmission services include the necessary patching and switching to permit service restoral in the event of partial system failures. This system will evolve in a way which permits it to

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system will evolve in a way which permits it to satisfy our current and near-term requirements as well as the long-range requirements of the late 1980s and 1990s. A number of projects have been defined which, when individually completed and integrated, will result in the NAS interfacility communications system. These projects are described in this chapter and in chapter III.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Activities already completed have upgraded system performance with emphasis on containing costs and providing a step toward the NAS interfacility communications system. These activities provided for the development of a firm foundation for subsequent network establishment.

A cost-savings project was initiated in 1981 to replace all teletypewriter-grade lines and teletypewriter equipment in Alaska where maintenance and leased-line costs are most severe. Outdated equipment has been replaced with higher speed, multiplexed services and state-of-the-art terminals. This service is fully leased. It has increased leased services costs by $400,000 per year, but it has led to the abolishment of 30 maintenance positions. Also, it has eliminated the need to buy expensive replacement parts for the 25-year-old, low-reliability teletypewriter equipment.

The system was expanded into the lower 48 states in 1982 and was expanded again in 1984 and 1985 through the teletypewriter replacement project.

Since the initial FAA computer modems were installed, methods of data transmission have improved significantly. FAA lowered costs by procuring high-speed multiplexing modems and using higher-speed circuits to replace multiple medium-speed circuits. Further economies are possible and efforts will continue in this area.

FAA-owned RMLs, used for special purpose communications, had appreciable spare capacity. By adding certain equipment, it was possible to use these links as trunks for general-purpose communications. For example, a long leased line can be replaced by a channel within an RML system and two local circuits. FAA has implemented this highly cost-effective method as the backbone of an FAA transmission network.

The FAA has begun to establish a National Airspace Data Interchange Network (NADIN). NADIN will form the nucleus of an FAA switched data network. NADIN will provide greater capability to switch messages throughout the network and replace multiple, low-speed lines and switches with concentrators, switches, and high-speed lines. In addition to improving flexibility, NADIN will save several million dollars annually in leased-line costs. The NADIN buildings are sized to allow the eventual replacement of the NATCOM computers, reducing leased services costs and facility overhead.

A number of management-related actions are underway to improve interfacility communications services at lower costs. The FAA is examining its total management information system needs and will create an information system which will provide better cost tracking, accountability, and flexibility in ordering leased service. A systems support contractor has evaluated all interfacility communication needs and has defined basic system interconnections and equipment needed.

NEAR TERM (TO 1990)

There will be significant changes as the FAA communications system evolves into a comprehensive integrated network. A key element of this evolution is the network design. The network design accommodates NADIN expansion, RML expansion, satellite trunking, and network management.

The NADIN system will evolve into a general purpose, data transmission system with alternate routing capabilities to bypass failed or saturated areas. It will be the nucleus of the FAA switched data telecommunications system.

Multiplexing will continue and allow facilities requiring access to the communications network to do so in a cost-effective manner. It will eliminate a large percentage of dedicated or individual lines. Multiplexed circuits will be used to connect multiple remote points to the network's backbone.

Many multiplexed tails or spur lines will terminate at such facilities as airport traffic control towers where multiple, low-speed systems (for items such as weather observation, surveillance, etc.) will exist.

During the near term, transmission media will likely be a mix of satellites, leased circuits, and radio links. Current analysis indicates that it is cost-effective to upgrade and expand the FAA's RMLs to radio communications links (RCL) for general interfacility use. As shown on the maps, RMLs will be converted to RCLs in a configuration suitable for many backbone and tail circuit uses. Cost performance of satellite transmission, however, is improving; and for long-distance, high-density communications, satellites will probably be more cost-effective. Satellites may also be used to back up the FAA transmission system in the event of catastrophic failure or extended outages of a primary communications node. Thus, toward the end of the period, some new mix of satellite, FAA-owned, and leased transmission is likely.

A network management system will be implemented during this time frame to provide restoral functions and management of the network. Initially, the system will use semiautomatic restoral switching with most control decisions made at the lowest level, usually at the ARTCC/ACF facility. Both NADIN and VSCS include automatic rerouting of message and voice traffic in the event of transmission system failures. A higher level of centralized network monitoring and control will be established to resolve multiple failures and/or global issues.

By 1990 new voice communications switching equipment will be installed in many facilities. This will limit leased equipment costs, provide better operational features, and allow greater flexibility in reconfiguring positions during off-peak traffic periods. ICSS will be used in automated flight service stations, ATCTs, and TRACONs. Additionally, new solid-state radio control equipment will be used to improve system reliability and reduce maintenance and logistics costs.

By accomplishing the above, a comprehensive communications network will be established. It will encompass satellite links, RML backbone, tail circuits, local area, and switching and control equipment. The network will be designed so that facility consolidation and activities requiring cost-effective communications can be supported.

LONG TERM (TO 2000)

In the long term, facility consolidation and new services such as Mode S data link and automated en route air traffic control (AERA) impose increasing interfacility requirements. The comprehensive network will accommodate these requirements. The appropriate technologies (including satellites) will be used. VSCS will be completed and a new tower communications switching system will evolve through applying VSCS technology to the tower switching systems.

Network control and monitoring will be automated at one or more centralized locations. This will maintain the global system configuration at optimum capacity and efficiency and reduce system restoral times.

The following diagram and maps describe the evolution of the system.

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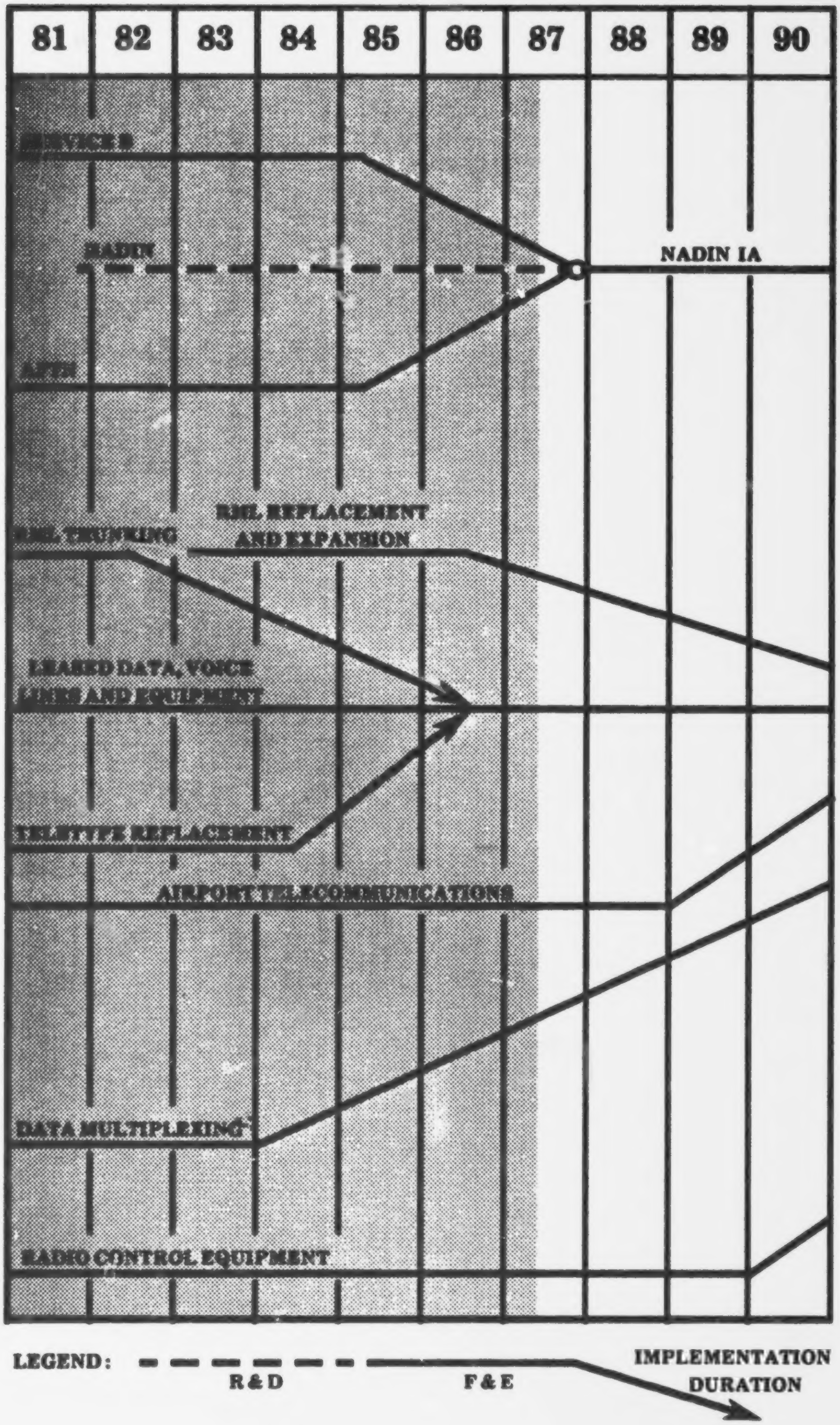

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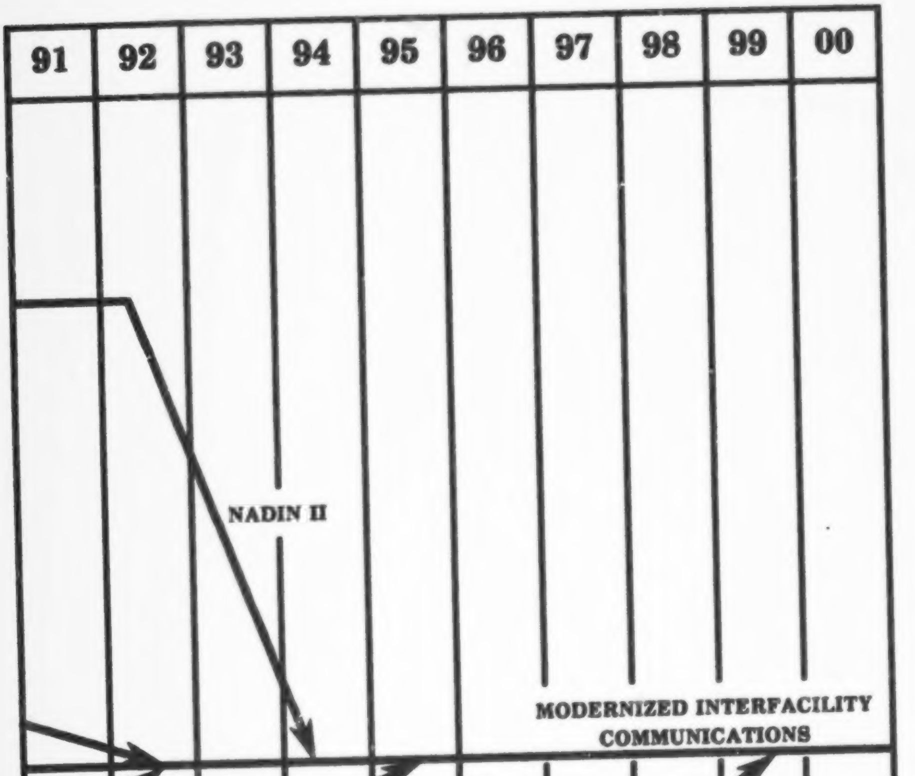

INTERFACILITY COMMUNICATIONS SYSTEMS EVOLUTION

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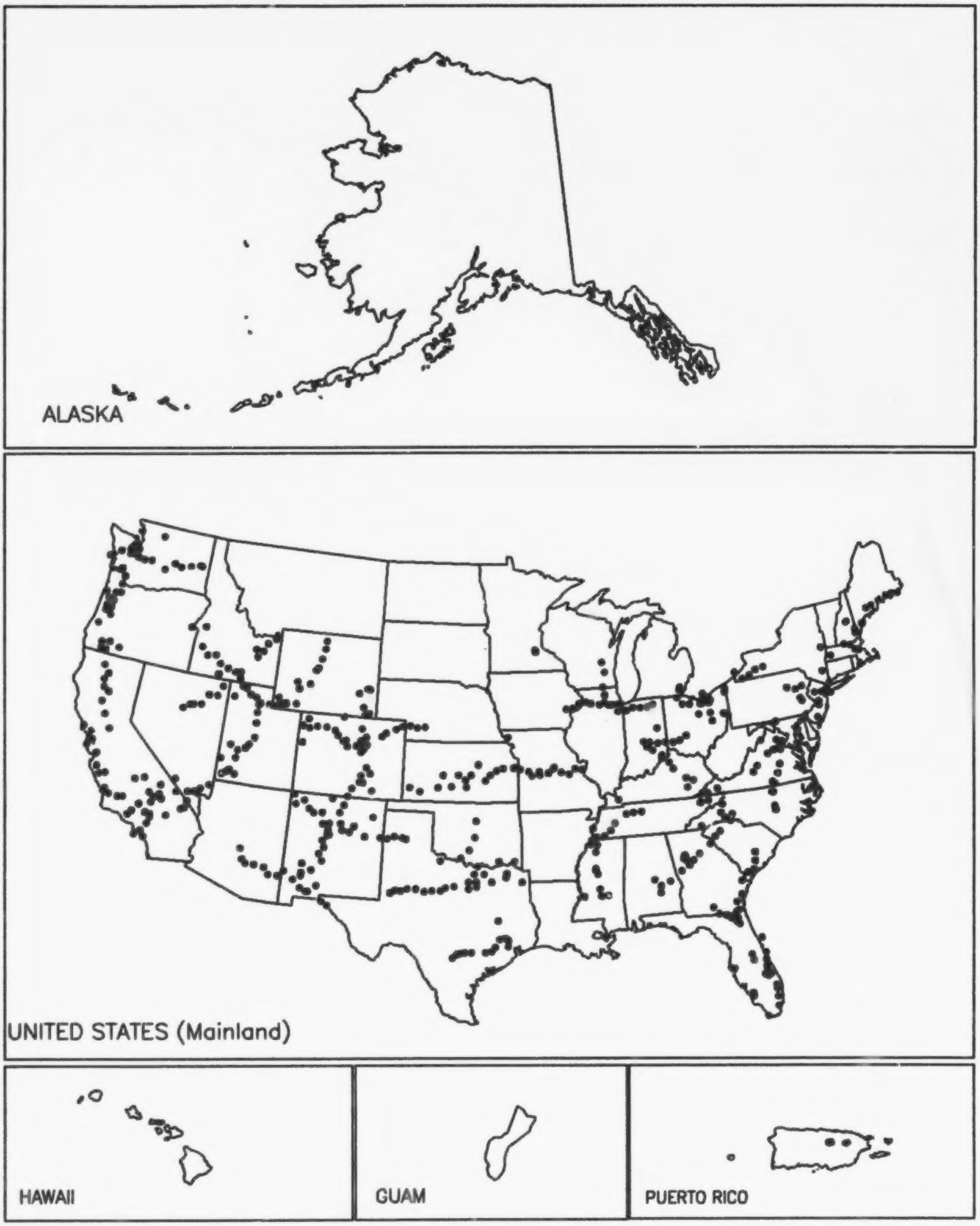
THIS MAP DEPICTS THE RADAR MICROWAVE LINK (RML) SYSTEM AS IT CURRENTLY EXISTS. THE RML PROVIDES A MEDIUM TO TRANSFER RADAR BROADBAND AND NARROWBAND DATA TO THE ARTCCs FROM REMOTE RADAR SITES. DATA MULTIPLEXING EQUIPMENT WAS RECENTLY ADDED TO REDUCE LEASED-LINE COSTS. BY 1990, THE SYSTEM WILL FORM THE INITIAL "BACKBONE" RCL VOICE AND DATA TRANSMISSION SYSTEM TO FURTHER REDUCE LEASED COMMUNICATIONS COSTS AND IMPROVE RELIABILITY.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1981 - 1985 SYSTEM
RADAR MICROWAVE LINK

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BY THE END OF 1990, MOST OF THE FAA'S MICROWAVE LINK NETWORK WILL BE IN PLACE AND UPGRADED TO RADIO COMMUNICATIONS LINKS (RCL). THE SYSTEM WILL FUNCTION AS A GENERAL TRANSMISSION TRUNKING NETWORK AND WILL FORM THE BACKBONE TRANSMISSION MEDIA FOR THE NAS INTERFACILITY COMMUNICATIONS SYSTEM (NICS). PATHS TO BE UPGRADED AND NEW PATHS TO BE ADDED WILL BE SELECTED ON THE BASIS OF TOTAL NETWORK CONNECTIVITY REQUIREMENTS AND AVAILABILITY OF ALTERNATE MEDIA WHERE COST-BENEFICIAL. THE CHART SHOWS TENTATIVE ALIGNMENT OF THE RCLs. THE ACTUAL ALIGNMENTS ARE SUBJECT TO ONGOING ENGINEERING ANALYSIS.

THROUGH THE YEAR 2000, FAA MICROWAVE LINKS WILL CONTINUE TO BE USED FOR TRUNK TRANSMISSION OF VOICE AND DATA BETWEEN MAJOR FACILITIES AND FROM REMOTE FACILITIES TO MAJOR FACILITIES.

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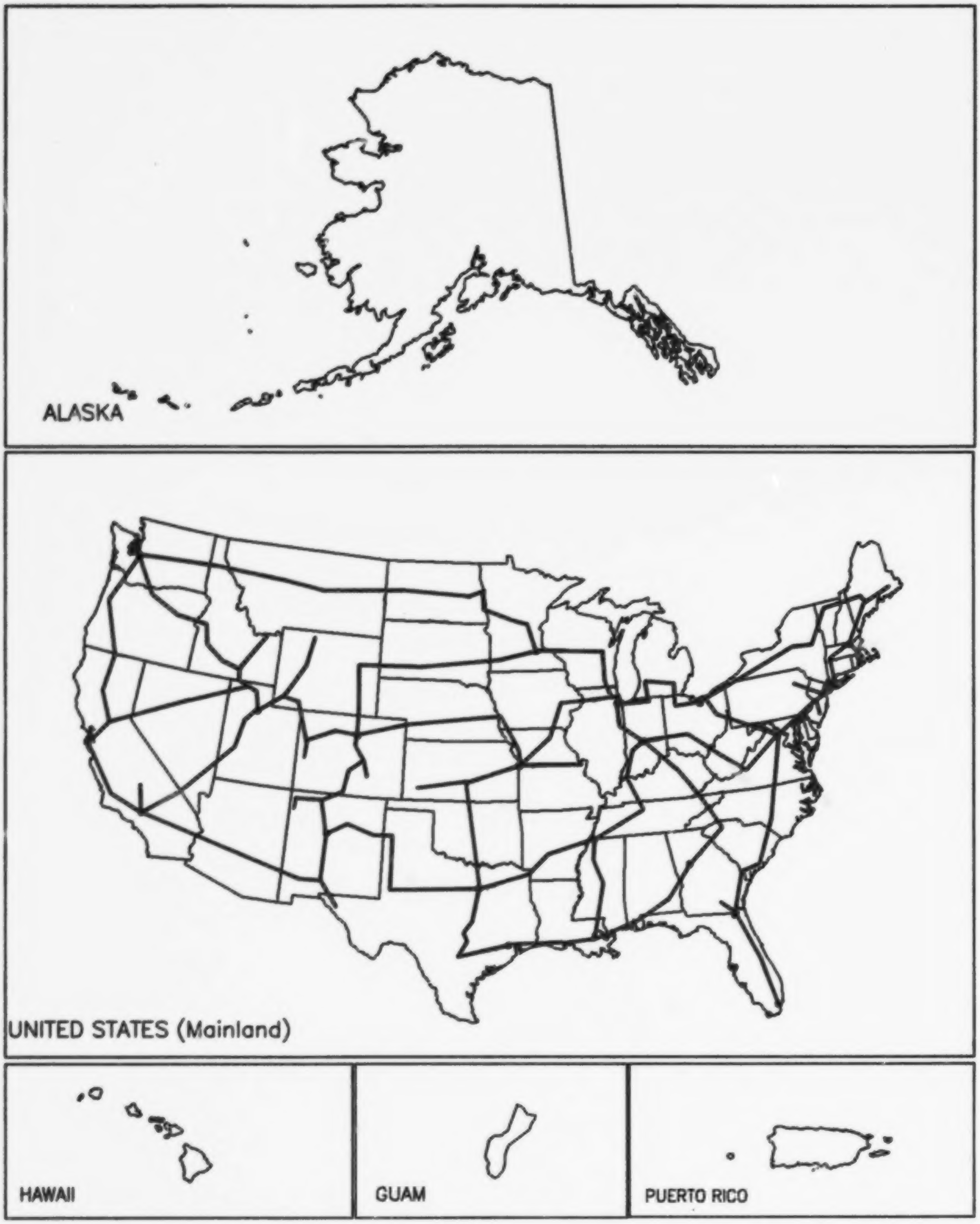
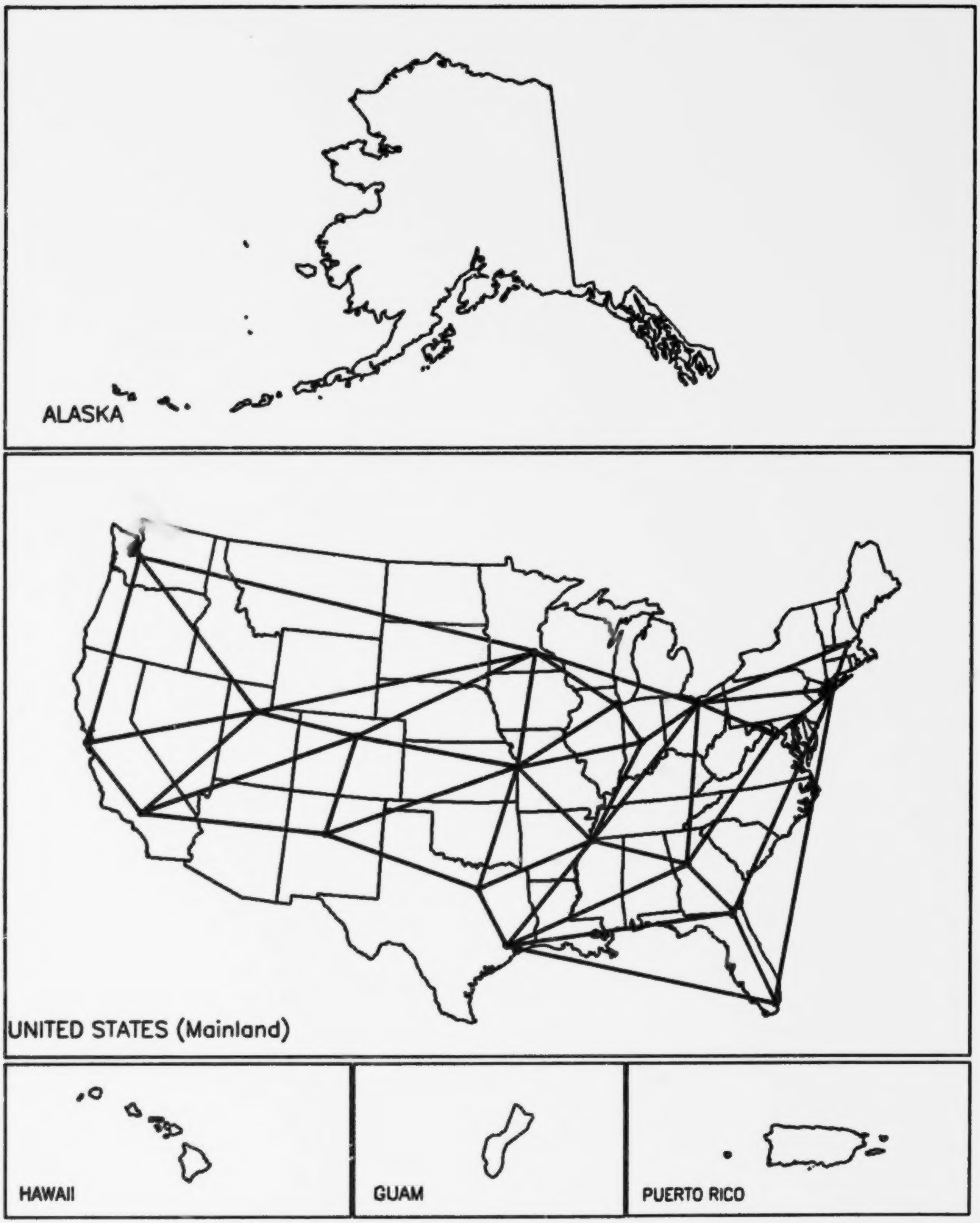

ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1990 - 2000 SYSTEM
RADIO COMMUNICATIONS LINKS

THE CURRENT ARTCC COMPUTER INTERFACILITY DATA LINES ARE DEPICTED ON THIS MAP. NOTE THAT THESE ARE POINT-TO-POINT LINES WITH NO THROUGH CONNECTIVITY (I.E., OAKLAND CANNOT COMMUNICATE DIRECTLY TO DENVER). ARTCCs ARE ALSO CONNECTED TO MANY ARTS FACILITIES. FDIO/FDEP LINES TO ATCTs ARE NOT SHOWN FOR CLARITY.

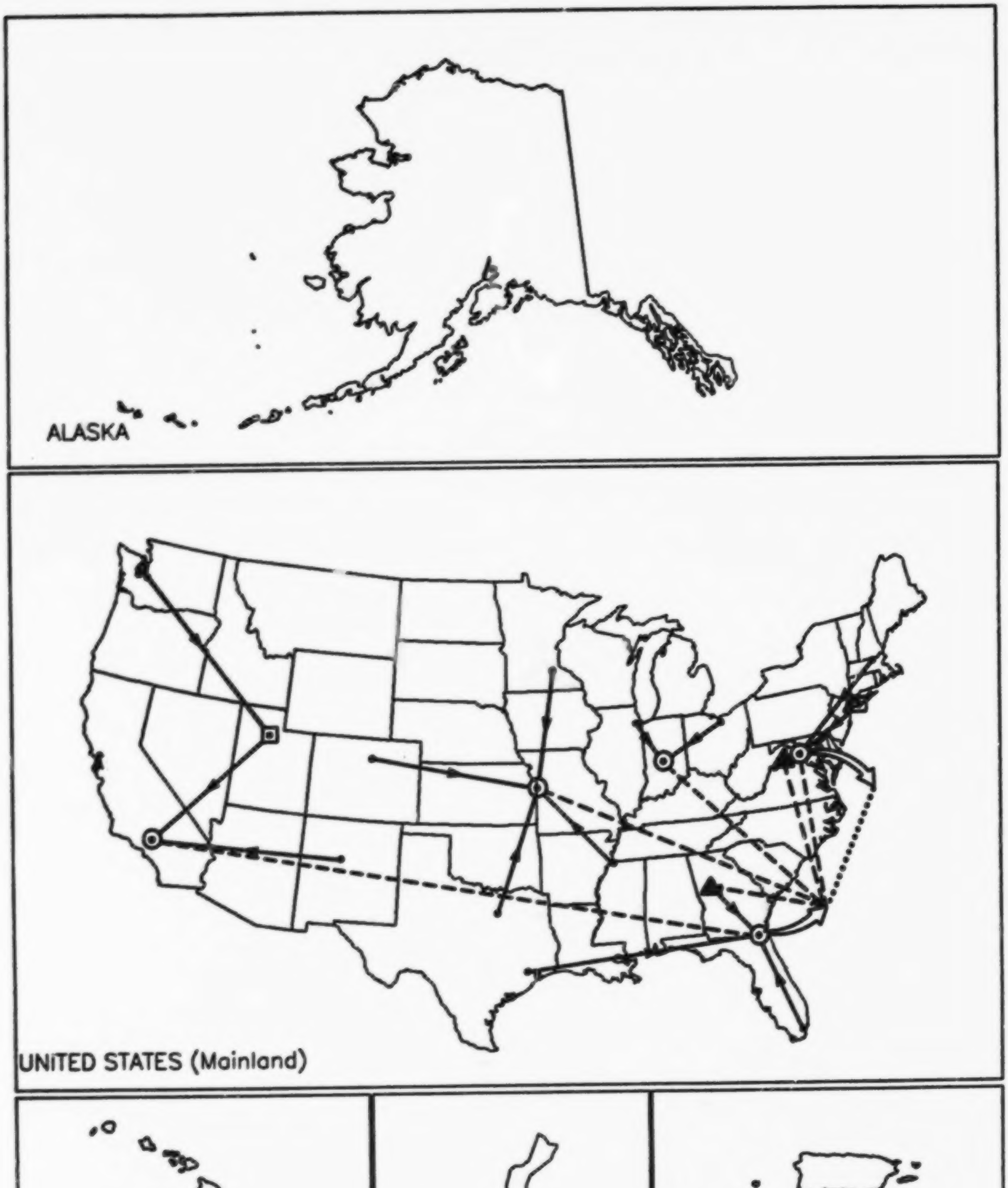
BY 1990, THE NADIN SWITCHING SYSTEM AND THE RCL BACKBONE TRANSMISSION SYSTEM WILL SIGNIFICANTLY IMPROVE THE COST-EFFECTIVENESS OF THIS SYSTEM.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1981 - 1985 SYSTEM
NAS/NAS INTERFACILITY

THIS MAP DEPICTS THE PREVIOUS CENTRAL FLOW CONTROL COMMUNICATIONS. DATA CIRCUITS CONSISTED OF 2,400 BPS LINES FROM FIVE STORE-AND-FORWARD ARTCCs TO THE JACKSONVILLE CENTRAL FLOW CONTROL COMPUTER. IN 1984, THE TRAFFIC MANAGEMENT SYSTEM WAS ESTABLISHED AND BEGAN CONVERTING TO NEW COMPUTER FACILITIES AT ATLANTIC CITY, NEW JERSEY, WITH OPERATIONS IN FAA HEADQUARTERS.

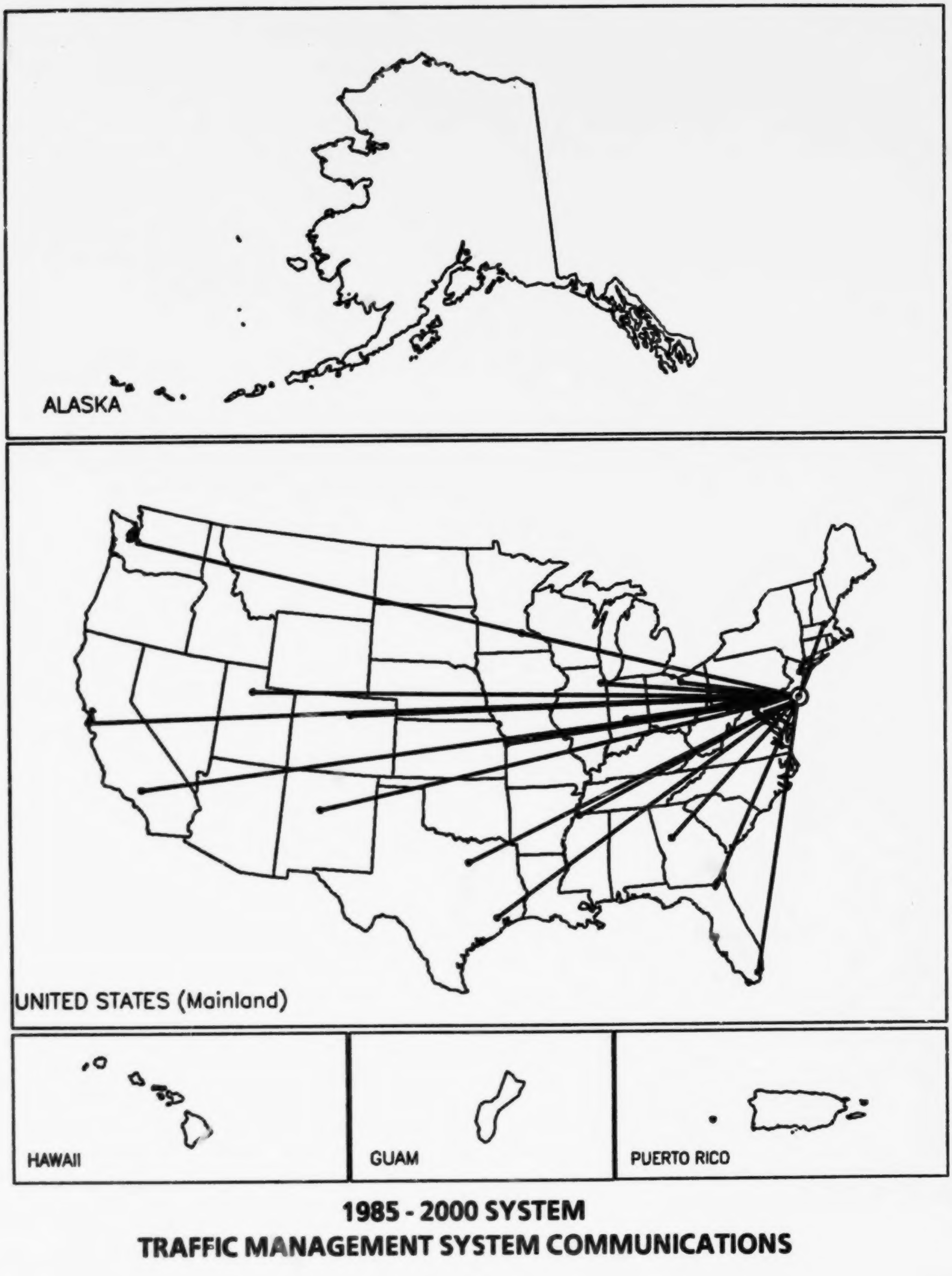
▲	**ARTCC EMERGENCY OPERATING FACILITIES**
●	**ARTCC (NODE)**
⊡	**ARTCC (RELAY CENTER)**
◉	**ARTCC (STORE-AND-FORWARD CENTER)**
– – –	**NEW DEDICATED 2,400 BPS DATA CHANNELS**
••••••	**NEW MULTI-4800 BPS DATA CHANNELS**


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1981 SYSTEM
CENTRAL FLOW CONTROL COMMUNICATIONS SYSTEM

THIS MAP DEPICTS THE CURRENT SYSTEM OF PROVIDING COMMUNICATIONS FOR TMS OPERATIONS. TMS DATA CHANNELS FROM THE ARTCCs TO THE TMS COMPUTER AT THE FAA TECHNICAL CENTER ARE PROVIDED BY THE DATA MULTIPLEXING PROJECT AND SHARE THE USE OF LEASED VOICE GRADE CIRCUITS WITH DATA CHANNELS FROM OTHER PROJECTS.

◎	**TMS COMPUTER COMPLEX, ATLANTIC CITY, N.J.**
△	**AIR TRAFFIC CONTROL COMMAND CENTER, WASH., D.C.**
●	**ARTCC (TRAFFIC MANAGEMENT UNIT)**
⇦	**EIGHT 14,400 BPS DATA CHANNELS**
—	**ONE 14,400 BPS DATA CHANNEL**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UNITED STATES (Mainland)
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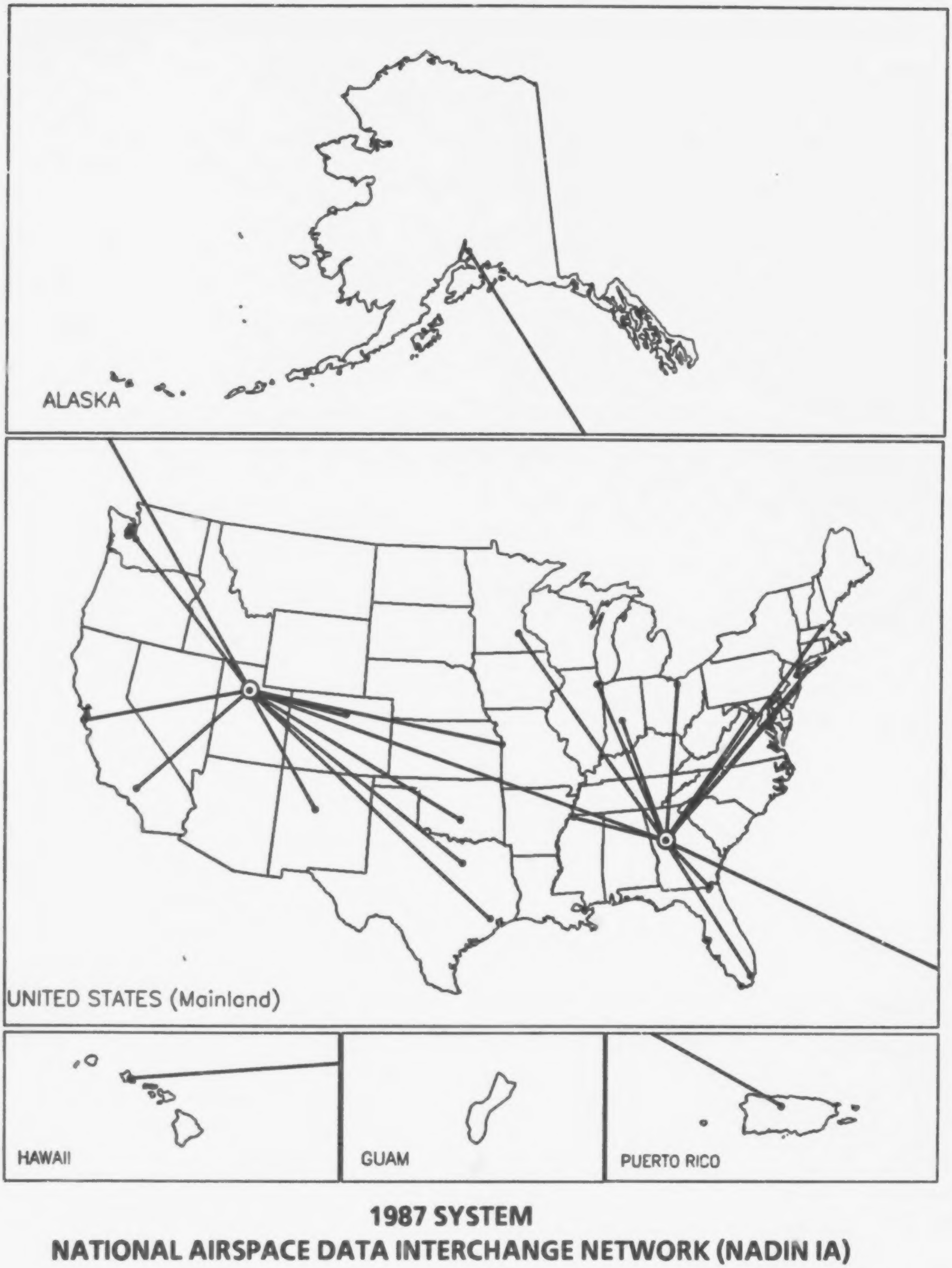
GUAM
PUERTO RICO

1985 - 2000 SYSTEM
TRAFFIC MANAGEMENT SYSTEM COMMUNICATIONS

IN 1987, THE NADIN DUAL STAR CONFIGURATION REPLACES THE AFTN, SERVICE A AND SERVICE B MULTIPLE LOW-SPEED SERVICES. MESSAGE SWITCHES WILL BE LOCATED AT SALT LAKE CITY AND ATLANTA AND CONCENTRATORS WILL BE LOCATED IN EACH ARTCC. DUAL BACKUP IS PROVIDED. TOTAL CIRCUITS FROM CONCENTRATORS TO OTHER FACILITIES ARE NOT SHOWN FOR CLARITY.

○ LOCATION OF NADIN MESSAGE SWITCHES

● LOCATION OF CONCENTRATORS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1987 SYSTEM
NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN IA)

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THIS MAP SHOWS TYPICAL ENHANCED NADIN CONNECTIVITY WHEN NADIN EVOLVES FROM A DUAL STAR CONFIGURATION (1987) TO A PACKET NETWORK WITH ALTERNATE ROUTING CAPABILITY (1991). ALTERNATE ROUTING ALLOWS DATA TO BYPASS FAILED OR SATURATED CIRCUITS. NADIN PROTOCOL DESIGN WILL BE MEDIA INDEPENDENT AND ALLOW ANY COST-EFFECTIVE TRANSMISSION MEDIA MIX TO BE USED. BY THIS TIME, IT IS EXPECTED THAT NADIN, TOGETHER WITH ITS MULTIPLE TAIL CIRCUITS, WILL HAVE ABSORBED ALMOST ALL INDEPENDENT FAA DATA CIRCUITS. ACTUAL CONNECTIVITY IS SUBJECT TO ANALYSIS. TRANSMISSION FACILITIES WILL BE PROVIDED BY THE RCL "BACKBONE" NETWORK.

○	**LOCATION OF NADIN MESSAGE SWITCHES**
●	**LOCATION OF CONCENTRATORS**
△	**LOCATION OF PACKET SWITCHES**

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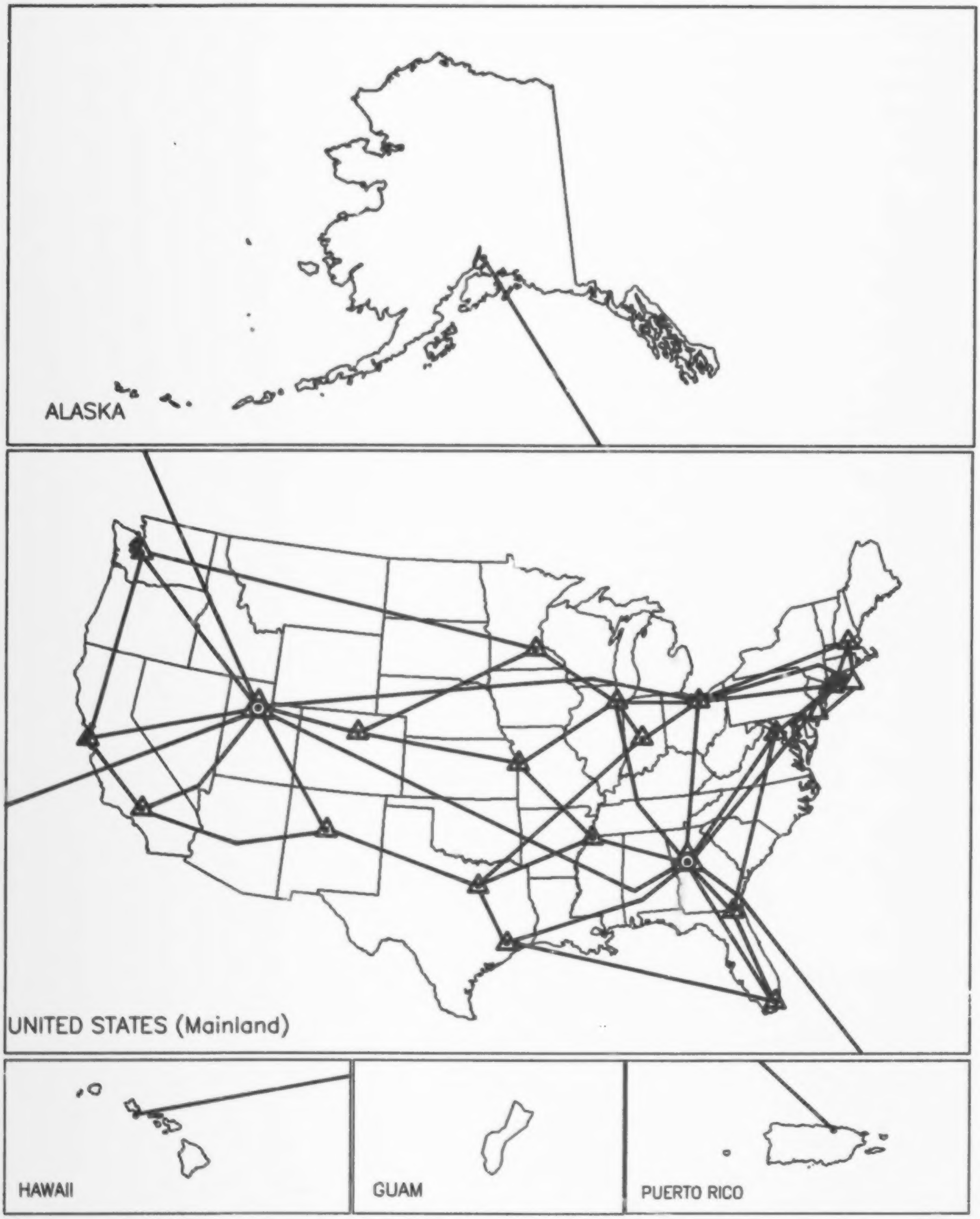
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HAWAII
GUAM
PUERTO RICO

1991 SYSTEM
NATIONAL AIRSPACE DATA INTERCHANGE NETWORK (NADIN II)

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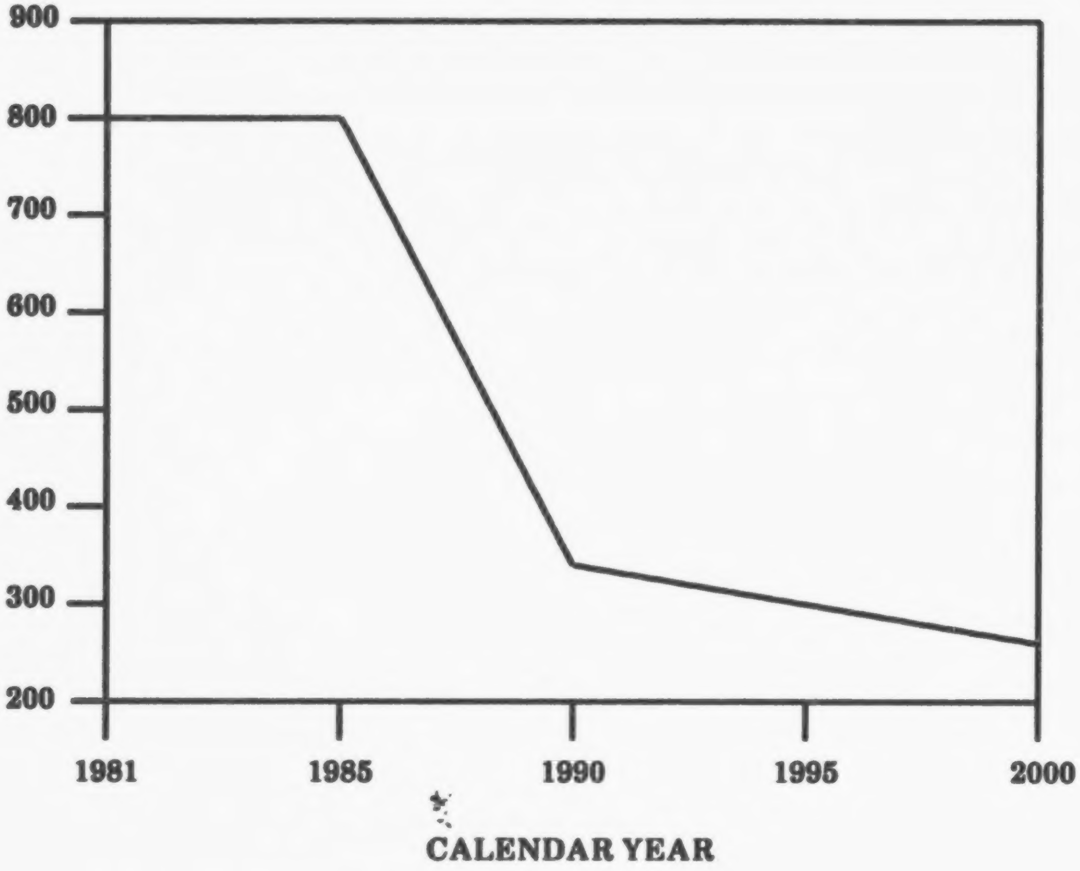
RETURN ON THE INVESTMENT

As a result of these planned actions, overall agency operating costs will be significantly reduced. The introduction of new technology will allow for a decrease in maintenance staffing despite the expansion of FAA-owned facilities to reduce reliance on leased systems. Leased service costs will be contained, and a more reliable and flexible data and voice transmission system will be available.

FIELD EMPLOYMENT

Employment levels reflect the Airway Facilities sector management and subordinate positions required to staff the interfacility system. Air Traffic staffing is not required for this system.

During the next 13 years, the interfacility system will undergo changes in hardware, software, and plant improvements. These changes will be reflected within Airway Facilities as shown in the chart below.



AIRWAY FACILITIES EMPLOYMENT
(INTERFACILITY COMMUNICATIONS SYSTEMS)

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The changes planned through the year 2000 will decrease current Airway Facilities personnel requirements for maintenance of interfacility systems at field facilities by 66 percent.

SUMMARY OF FACILITY CHANGES

1981 - A total of 799 field airway facilities technicians were required to maintain the interfacility communications systems.

1985 - High-speed data multiplexing has reduced the number of leased circuits needed to provide long-range radar data to en route centers. Improvements to the RML system have reduced maintenance tasks. Integrated communications switching systems (ICSS) are being installed at towers, TRACONs, and the initial automated flight service stations. The telecommunications management system was upgraded. The teletypewriter replacement program has substantially replaced approximately 350 labor-intensive installations with modern leased terminal equipment. Staffing has increased slightly; however, due to additional communications and TML links, maintenance of the NADIN concentrators and transition to leased teletype replacement systems.

1990 - Additional high-speed data multiplexing will be added, the initial National Airspace Data Interchange Network NADIN IA will be implemented, vacuum-tube RML equipment will be replaced with solid-state RCLs, various RCL systems will be interconnected to form a national network, and about 40 additional television microwave links will be added to provide radar data to satellite towers. Staffing requirements will be reduced to 346.

2000 - Facility consolidation, continued expansion of NADIN functions and the RCL network, NADIN II will be implemented, and replacement of leased voice switching systems with agency-owned equipment will continue to reduce overall staffing and operating costs.

Outyear estimates are reviewed annually and are subject to revision.

INTERFACILITY COMMUNICATIONS SYSTEMS AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS

	1981	1985	1990	2000
Operations (Millions)	151.5	143.5	153.7	185.7
Airway Facilities Personnel	799	804	346	274
AF Productivity Quotient	189,612	178,483	444,220	677,737
Airway Facilities Personnel Costs (Thousands)	$27,246	$27,416	$11,799	$9,343

PROGRAM RELATIONSHIPS

The objective of the NAS Plan is the creation of a fully integrated air traffic control and navigation system capable of meeting the capacity, efficiency, and air safety demands anticipated by the turn of the century. Its projects are interrelated.

The NAS interfacility communications system (NICS) forms the connective and transmission network to tie together the many components of the National Airspace System. The NICS plays a major role in assuring that the most efficient and reliable communications switching and transmission modes are used. Virtually all of the new systems require data or voice communications to other facilities and will use the services provided by the NICS. The programs described in this chapter establish a national communications network which will use standardized switching systems and a backbone transmission system of microwave links. The NICS will, however, encompass many of the present and future leased communications services provided by outside vendors when those services are determined to be, at least, as reliable and more cost-effective than using FAA-owned systems.

As flight service facilities are consolidated into the AFSSs and radar approach control facilities are merged into the ACFs, the need for more and better communications capabilities, along with lower unit costs, becomes very apparent. Voice communications, the predominant mode of the present system, will give way to increasing amounts of digital data communications for virtually all systems. Air route traffic control centers (and later, ACFs) will be digitally interfaced with nearly every type of facility within the bounds of their control areas as well as adjacent en route facilities. AFSSs will require high-speed digital communications with FSDPSs located at ARTCCs/ACFs. Tower suites will communicate intensively with the ACFs, passing radar and tracking data, as well as coordination between controllers. Remote weather-collection facilities, radar and air/ground communications sites, navigation and landing facility remote monitoring systems, and national networks for traffic management and weather information will all add to the present data switching and transmission requirements as the NAS is implemented. The projects presented in this chapter are designed to not only accommodate this growth in data, but to do so with reduced operations costs.

The projects are grouped into three general categories: those which improve the transmission subsystem that carries voice and data between facilities, the switching subsystem which provides the proper connectivity between users, and one project, now completed, which replaced the obsolete teletypewriter equipment.

TRANSMISSION

The RML trunking project, which is now completed, utilizes excess signal-carrying capacity of the current RMLs to transmit between ARTCCs. Multiplexing modems provide the capability to mix data from many sources on a single transmission medium and separate it at the receiving end. Many multiplexing modems are already in place and are proving to be highly cost-beneficial. The obsolete and maintenance-intensive radar microwave links will be replaced with modern, reliable radio communications links (RCL). Some expansion of the existing network is necessary to provide a national backbone of interconnected links which will have the capacity to handle virtually all of the ACF-to-ACF data/voice communications as well as much of the tower, flight service, weather collection and dissemination, and remote maintenance monitoring data. Completing the transmission subsystem are two projects which will benefit the terminal facilities--the TML project (now combined with the BRITE Project, 2-16) which provides the path for television-formatted radar displays at satellite towers, and the airport telecommunications project which improves the control and monitoring capabilities at small and medium airports.

SWITCHING

The National Airspace Data Interchange Network (NADIN) provides the connectivity required to route vast quantities of data from many sources to the intended recipients. NADIN is being implemented in two phases: NADIN IA, to be completed this year, provides the basic system of concentrators and switching centers to take advantage of the initial data transmission network and to replace many leased circuits and nonstandard leased terminal equipment. NADIN II will expand on NADIN IA to provide increased capacity, flexibility, and service availability through an improved system architecture. The RCE project replaces the obsolete tone control equipment used to control remote air/ground communications sites with a modern system, incorporating remote maintenance monitoring in its design.

OTHER IMPROVEMENTS

The teletypewriter replacement project, now completed, provided modern interfacility communications terminals to replace the obsolete teletypewriter units in use since the late 1950s.

PROJECTS	IMPLEMENTATION	
	FIRST	LAST
TRANSMISSION		
1. RML Trunking	PROJECT	COMPLETE
2. Data Multiplexing	1983	1995
3. RML Replacement and Expansion	1986	1992
4. Television Microwave Link (TML)	COMBINED	WITH BRITE
5. Airport Telecommunications	1989	1992
SWITCHING		
6. National Airspace Data Interchange Network (NADIN) IA	1987	1987
7. National Airspace Data Interchange Network (NADIN) II	1992	1995
8. Radio Control Equipment (RCE)	1990	1999
OTHER IMPROVEMENTS		
9. Teletypewriter Replacement	PROJECT	COMPLETE

PROJECT SUMMARY

PROJECT 2: Data Multiplexing

Purpose: Lower cost leased communications and maintenance results from using data multiplexing equipment. This equipment consolidates information, currently requiring multiple lines, and transmits it over fewer lines. The use of data multiplexing is an integral part of FAA's strategy for cost-effective interfacility communications transmission.

Approach: Where information is being transmitted over multiple low-speed lines, multiplexing modems and statistical multiplexers will combine the data and transmit it over a single line, thus, replacing the low-speed circuits. The high-speed multiplexing modems will also provide capacity for new NAS Plan requirements. Applications include: en route radar site to ARTCC data, ARTCC to ARTCC data, terminal to ARTCC data, NEXRAD to ARTCC data, and FSDPS (at ARTCCs) to AFSS data.

Readily available off-the-shelf multiplexing equipment will be used. It promises amortization of multiplexing costs in less than 2 years. A monitoring and analysis capability is incorporated as part of the modem equipment. Modem monitoring and end-to-end monitoring of the transmission media will be reported to a monitoring and control console at each ARTCC. This monitoring capability will improve the reliability of data flow and reduce maintenance costs. The equipment monitors transmission media and provides a means of predicting potential failures before loss of data occurs and pinpointing failure locations when they do occur. Additionally, automatic logging of failures will assist in recovery of leased-services costs.

This project is being accomplished in three phases: (1) en route and TMS, (2) terminal, and (3) expansion/reconfiguration. The major hardware building blocks are the 14.4K bps multiplexing modem and statistical multiplexers. Monitoring and control systems are installed at each ARTCC.

Commercially available equipment is being initially leased using a requirements-type contract. An option to buy is included in the contract. This option is being exercised after equipment has been put into operation.

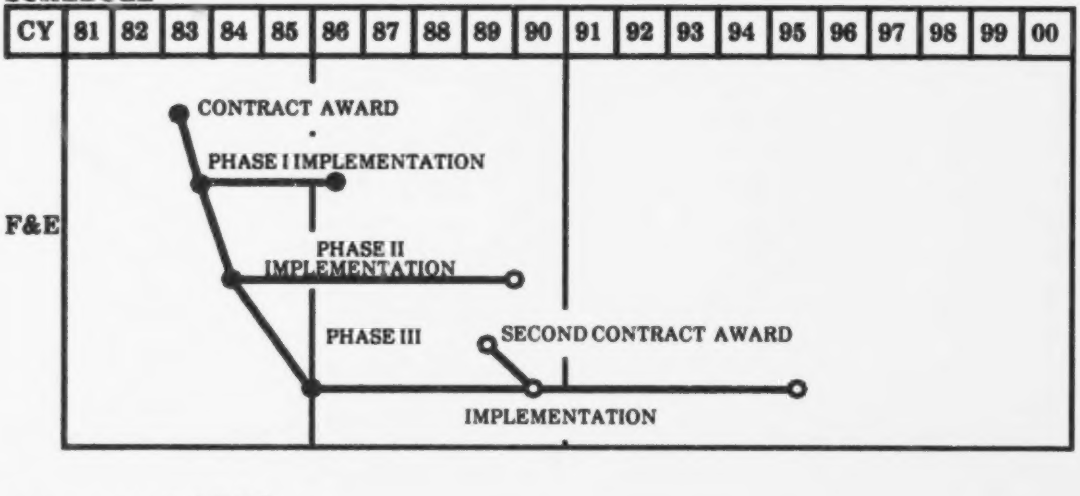
A second contract is required to fulfill requirements of Phase III.

Products:

- Phase I will provide multiplexing modems to be distributed to 20 ARTCCs and 150 radar sites.
- Phase II will provide additional units for terminal facilities, along with discrete statistical multiplexers.
- Phase III will replace modems for AFSS to FSDPS data, and provides multiplexing modems, T1 multiplexing equipment, statistical multiplexers and associated equipment required to meet the communications requirements of the AWOS, CBI, NEXRAD, Mode S, TMS, TDWR and RMMS projects. This phase will also include reconfiguration of the existing Phase I and II networks to utilize RCL transmission facilities.

Related Projects/Activities: A majority of NAS Plan projects which require transmission of data from point-to-point will have the information consolidated for transmission over a single line by multiplexing.

SCHEDULE



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PROJECT 3: RML Replacement and Expansion

Purpose: The FAA RML system consists of outdated equipment which is expensive to maintain. This system is required to transmit broadband radar data until late in the 1980s. It must be replaced.

To maximize the cost-effectiveness and availability of the interfacility voice and data transmission needed in the future, an integrated transmission system must be implemented. This system must consider the total traffic, both national and area.

This project contributes to the above objectives by providing modern national microwave radio communications links (RCL) forming a network for voice, data, and broadband radar with capacity for future requirements and redundant and alternate routing capability.

The network will eventually tie together all ACFs and many other facilities which have large communication needs. The RCLs along with other leased or FAA-owned transmission media will be used to satisfy national communications transmission requirements as well as area network trunking.

This project will ensure the reliable transmission of radar data, reduce the cost for interfacility communications, and improve system availability while providing the flexibility to accommodate the interfacility communications requirements of the NAS Plan.

Approach: An analysis was completed to develop a network design by examining user requirements and FAA objectives with respect to the performance-cost aspects. Transmission alternatives were analyzed, including satellites and leased circuits. Based on this analysis, plans for an overall comprehensive backbone network have been developed which use the existing RML as a basis, supplemented by leased circuits, area networks, satellites, and other FAA links where cost-effective.

The RML replacement system will serve as a general transmission medium for FAA voice and data communications. It is highly cost-effective to convert existing special-purpose links used for radar remoting to general-purpose links (RCLs) used for interfacility communications. The existing RML links will be upgraded, and additional links will be established to complete a nationwide network. Monitoring of RCL equipment and path integrity will be done with diagnostic and monitoring equipment obtained as part of the RCL network.

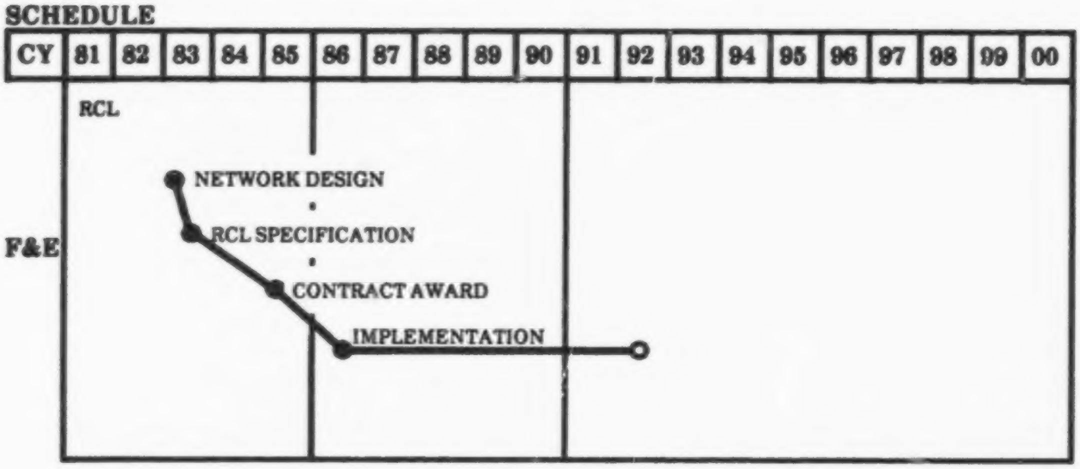
Network Monitoring and Control Equipment (NMCE) will be procured separately to provide RCL network monitoring and to ensure reliable service to ACFs. The NMCE will monitor end-to-end channel integrity. It will provide rerouted service to the primary ACF in case trunks fail and alternate routed service to a backup ACF in case the primary ACF fails. The NMCE will supplement channel monitoring functions with inputs from the Data Multiplexing Analysis System and RCL diagnostic and monitoring equipment.

Products:

- RCL network plan.
- Specifications for RCL.
- Replacement of present 750 RMLs.
- Establishment of additional 250 RCL facilities.
- Network monitoring and control equipment.

Related Projects/Activities: Data Multiplexing will consolidate data for transmission over the RCL network. NAS Spectrum Engineering support is required to provide interference-free operation. Other NAS Plan programs/projects such as AFSS, RMMS, AAS, ACF, Mode S, and ASR-9, which require data or voice transfer between sites or facilities, will utilize the RCL system as the transmission media.

SCHEDULE


CY
RCL
F&E
NETWORK DESIGN
RCL SPECIFICATION
CONTRACT AWARD
IMPLEMENTATION

PROJECT 5: Airport Telecommunications

Purpose: This project will establish the specifications and criteria for a reliable and flexible signal distribution system for low-activity and medium-activity (Levels I, II, and III) airports. Control, signal, and communication cables at many airports are reaching the point where replacement is necessary for reliable or expanded operation. This program will enable the replacement of deteriorating cables at airports with systems employing new technology, such as fiber optics and RF data link.

Replacement of the cables with new technology will:

- Eliminate outages caused by slowly deteriorating or failing copper cables.
- Reduce leased service costs by use of FAA fiber optic system or RF data link.

Fiber optic installations will:

- Reduce installation costs when installed concurrently with power cable loop systems.
- Eliminate cable damage from lightning surges.
- Reduce interference from noise intrusion.

Replacement of the cables at low-activity and medium-activity airports with RF data links or fiber optics, rather than replacement in-kind, will provide cost-effective, state-of-the-art support for remote maintenance monitoring.

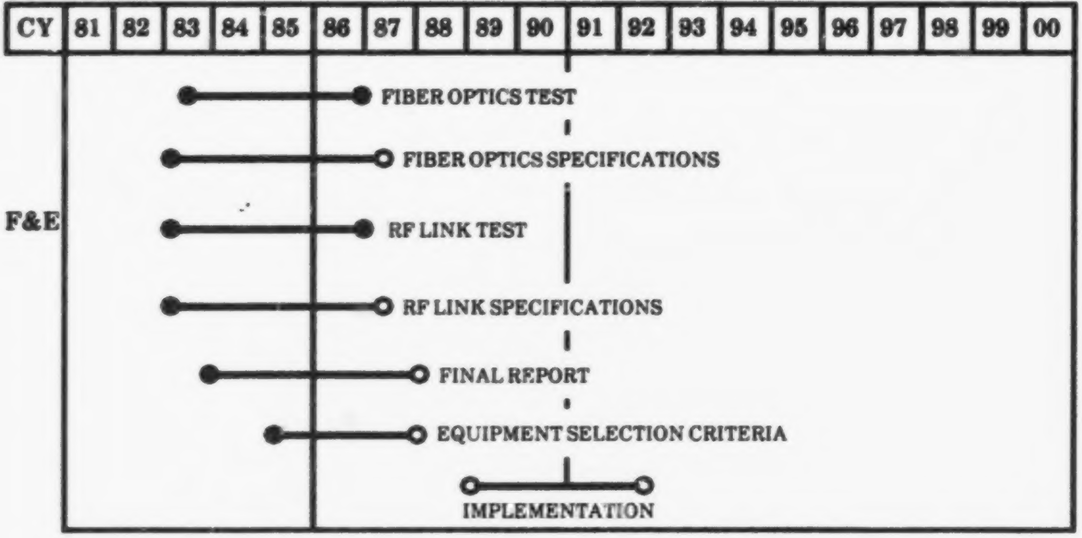
Approach: Planning for cable replacement at the low-activity and medium-activity airports will include an engineering analysis to determine the utilization of fiber optics, RF data link, or other methods.

Products:

- Test results, specifications and criteria for new technology to replace deteriorating airport cables.
- A limited number of airports will be provided funding for fiber optic or RF data link installation.

Related Projects/Activities: Airport Telecommunications is related to all airport projects (such as RMMS, MLS, ILS, etc.), which require buried cable for control, signal, or communications between sites. NAS Spectrum Engineering will provide interference-free frequencies for Airport Telecommunications, and will investigate spectrum-efficient communication technologies to satisfy this and other NAS Plan projects requiring RF data links. The emphasis will be on establishing an integrated system to satisfy total RF data link requirements in the airport environment. Airport telecommunications at Level I, II and III airports will be implemented as part of a Sustain Telecommunications Support project.

SCHEDULE



PROJECT 6: National Airspace Data Interchange Network (NADIN) IA

Purpose: The NADIN is a national digital message switching network for aeronautical data that will initially replace a number of inefficient, independent, low-speed networks currently in operation and can be expanded to meet the future data switching requirements of most programs in this Plan. The initial NADIN system, or NADIN IA, integrates the AFTN and Service B, and provides service to the Teletypewriter Replacement project and to several FAA external users; i.e., airlines, ARINC, USAF, etc. In doing this, Service B data transmissions will be replaced by medium-speed data transmissions for use at Model 1 AFSS locations. NADIN IA provides switching service to the flight service data processing system (FSDPS) and aviation weather processor (AWP).

The cost of communications services is steadily increasing. The replacement of the existing FAA communications services and consolidation into NADIN results in savings in maintenance costs, economically provides for improved services and system expansion, improves reliability, reduces leased-line requirements, and consolidates FAA communications within the agency to provide the necessary system interoperability.

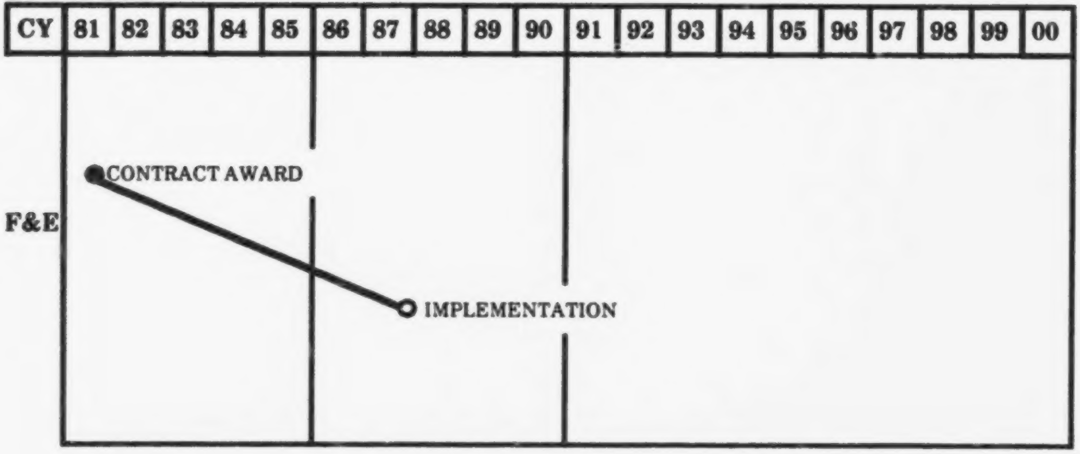
Approach: Establish an operational data switching system capable of satisfying the current and near-term requirements for data switching in the NAS. The system will replace the existing outdated equipment with modern equipment which requires less maintenance. The NADIN system will have modular expandability to meet data communications requirements for future systems. It will improve operational effectiveness; reduce operational cost through consolidation of independent, low-speed services; and provide better utilization feedback and system management capabilities.

Products:

- 2 operational switching centers (Atlanta and Salt Lake City).
- 23 operational data concentrators at ARTCCs.
- Support switch and concentrator at the FAA Technical Center.
- 2 training concentrators at the FAA Academy.

Related Projects/Activities: NADIN IA provides support for most current and near-term new FAA systems that require switched data communications. The RML Replacement and Expansion project will provide the transmission system for the data flow. International coordination is necessary to insure compatibility with ICAO's AFTN standards.

SCHEDULE



PROJECT 7: National Airspace Data Interchange Network (NADIN) II

Purpose: In addition to those data switching requirements that will be served by NADIN IA, it is necessary to expand the system to meet the data switching requirements of other major FAA systems and functions in this Plan (e.g., remote maintenance monitoring system (RMMS), AWP, CWP, WMSCR, advanced automation system, NEXRAD and the facility (center and terminal) consolidation program).

This project will provide the expanded data switching capability and network monitoring functions required to meet the future FAA communications needs for data switching. Increased capacity, flexibility, and service availability will be achieved through the use of packet switching and a highly connected system architecture to augment the dual-star of NADIN IA.

Approach: The system design will be based upon the data flow requirements of new systems and consolidation as the NAS evolves. A highly connected network using packet switch node virtual circuits and automatic alternate routing capability will be implemented. Two centralized network control and monitoring facilities also will be established. Standardization of access interface and exchange protocols will be maintained to ensure future flexibility for system evolution. Message switching will continue to be provided by NADIN IA and will be interconnected with the NADIN II packet switched network via two gateways. NADIN II hardware and software will be integrated and tested with the NADIN IA using the support system at the FAA Technical Center.

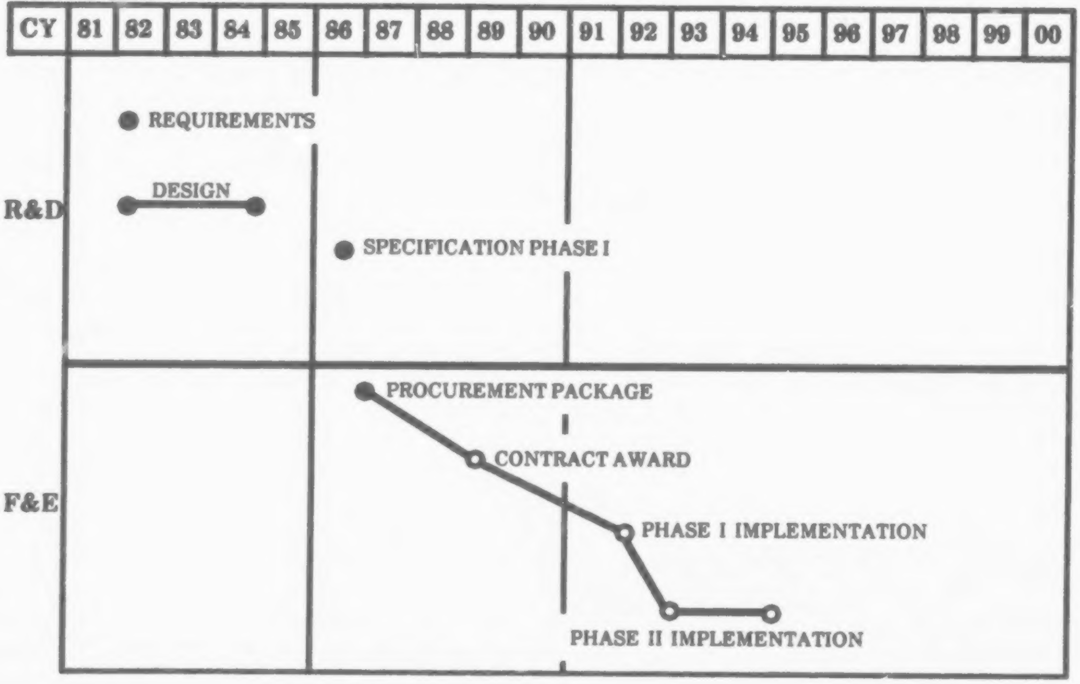
NADIN II will be a competitively acquired addition to NADIN IA. Two phases will be involved. Phase I will implement packet switching, packet nodes, and added transmission trunking between nodes. Phase II will add capacity, connectivity, and interfaces to the system.

Products:

- Approximately 24 operational packet switch nodes will be installed at 20 CONUS ARTCCs, two NADIN message switching centers, the New York TRACON, and the FAA Technical Center.
- Two support nodes will be provided to the FAA Technical Center.
- One support node will be provided to the FAA Aeronautical Center.
- Two Network Control Centers (NCCs) will be provided at Atlanta and Salt Lake City for centralized monitoring and control of the NADIN II network.

Related Projects/Activities: NADIN will interface with virtually all NAS operational systems requiring interfacility data switching service. Future needs for area control facilities/advanced automation system will be met by this NADIN expansion. NADIN will be used to switch maintenance management system communications. This project will require interfacility communications service from NICS. Projects providing that service include RML Replacement and Expansion which will provide the transmission network for data flow.

SCHEDULE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R&D
REQUIREMENTS
DESIGN
SPECIFICATION PHASE I
F&E
PROCUREMENT PACKAGE
CONTRACT AWARD
PHASE I IMPLEMENTATION
PHASE II IMPLEMENTATION

PROJECT 8: Radio Control Equipment (RCE)

Purpose: This project will replace the present radio signaling and tone control equipment to improve operational performance and reduce maintenance cost. The replacement of obsolete radio control equipment will eliminate operational deficiencies and improve air-ground service. This equipment will be used for control and remote maintenance monitoring of RCAG, RTR, RCO, and RCF facilities. Additionally, it will standardize the interface with VSCS, Tower Communications System, and ICSS. This equipment will include the line-combining function (multiplexing) required for FSS modernization and the facility consolidations.

Approach: The approach is to replace existing radio tone control equipment with modern equipment which uses presently available technology, performs current functions and services, and adds an RMM capability.

The initial contract under this project provides equipment to replace tone control equipment at ARTCCs and TRACONs/ATCTs, and their associated RCAG, RTR, and RCF facilities. The contract will also provide equipment for Level V ATCTs without radio signalling or tone control equipment and other locations supported by TAA.

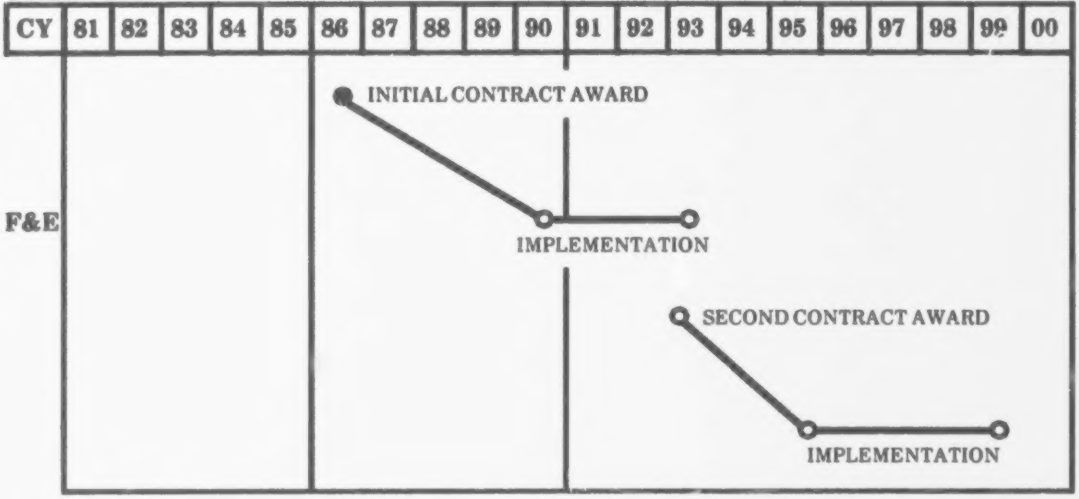
A subsequent contract will provide equipment to replace 1,690 channels of radio signaling equipment at AFSSs and associated RCO and RCF facilities. The contract will also provide 620 channels of equipment for the control of radios from the ACFs.

Products: Replacement of approximately 2,120 channels of tone equipment associated with ARTCCs and TRACONs/ATCTs starting in FY-90.

Installation of 2,310 channels of RCE for AFSS and ACF applications starting in FY-95.

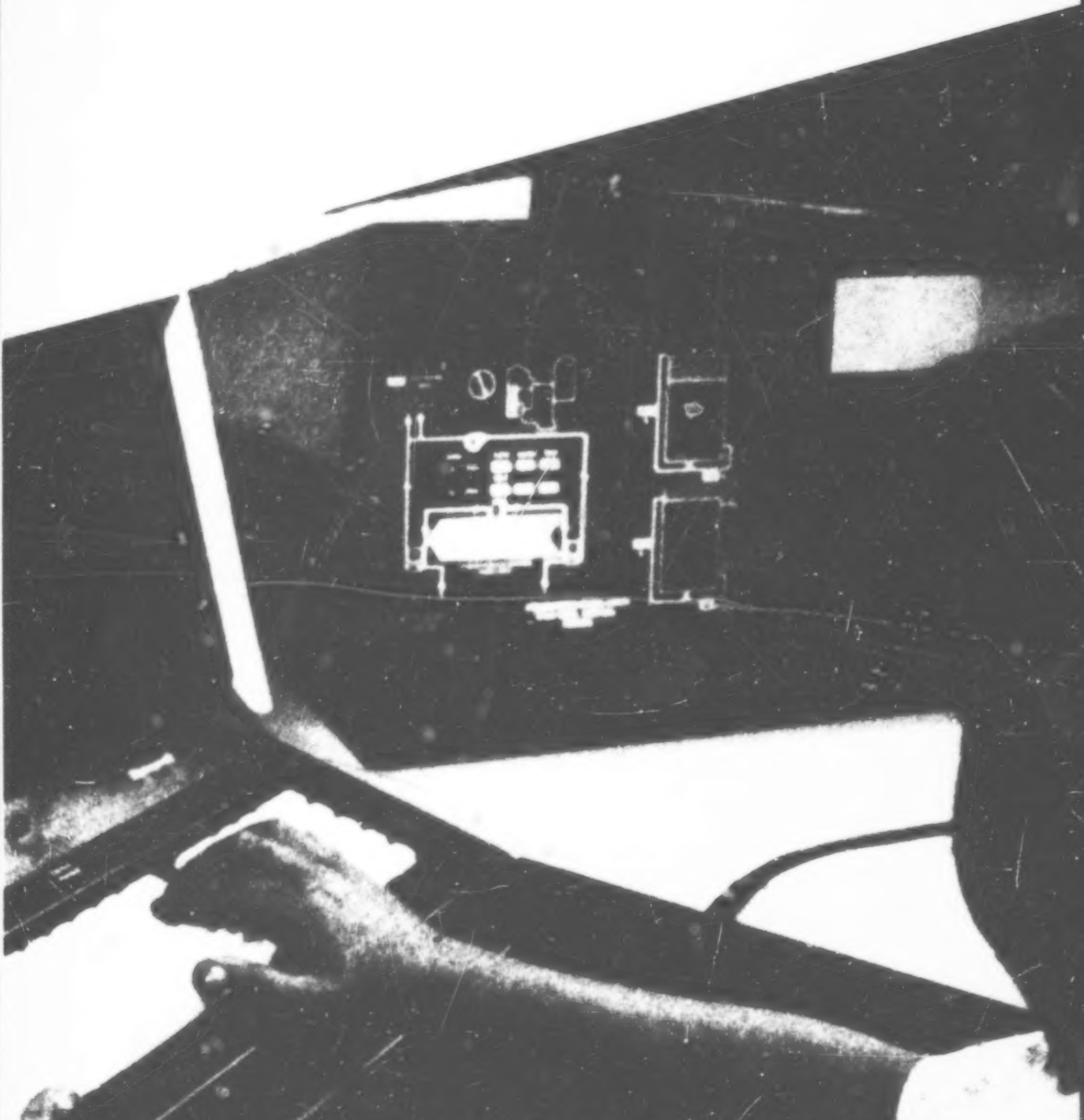
Related Projects/Activities: The radio control equipment will perform the radio channel signaling and control functions to support ground/air voice communications and connectivity between the voice switching equipment in the operation of air traffic control facilities. This includes VSCS in ACFs, TCS in ATCTs, ICSS in AFSSs, and the ground/air radio equipment in the remote communications facilities for RMMS.

SCHEDULE



CHAPTER VI

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS



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MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS

Maintenance and operations support systems are necessary for the operation and support of the National Airspace System. They include buildings; plants; access roads; special purpose vehicles; laboratory facilities at the FAA Technical Center; systems, sources or processes required for support of maintenance operations; flight inspections; emergency programs; and the facility and equipment (F&E) process itself.

This chapter focuses on improvements to flight inspection capabilities, maintenance support, emergency systems, power systems, structures, laboratories, and environmental support facilities.

The flight inspection program certifies the operation of FAA facilities that transmit the precision signals needed for navigation and surveillance. Currently, about 23,000 hours of flight inspection operations are performed annually out of five flight inspection field offices, a reduction from 27,000 hours and seven field offices in 1981. These operations include initial certification of new facilities, periodic inspections of facilities under FAA regulations, and certification of facility performance following accidents.

Maintenance support is accomplished by a staff of electronic and environmental technicians from approximately 650 duty stations associated with 81 sector offices. This reflects a reduction from 115 sector offices and approximately 1000 duty stations in 1981. This support usually consists of corrective and periodic preventive maintenance. It requires frequent site visits and, in some cases, the staffing of facilities to assure immediate response in the event of a required maintenance action.

Training for most of the technical work force is performed locally and at the FAA Academy in Oklahoma City. Training capabilities include resident training along with computer-based instruction and some correspondence courses. Execution of the FAA National Airspace System Plan will result in a modernized and cost-effective air traffic control system. Life-cycle support of new and existing systems must be equally cost-effective.

Advanced technology and concepts must also be explored for future integration into the NAS. Laboratories are required to support the present field operational systems and the exploration of advanced concepts. Laboratory facilities and systems are provided for these efforts. These facilities are used for development of hardware and software changes to the operational systems, technical support of field personnel, and operational testing and evaluation of new systems.

National field engineering support is provided by a cadre of technical experts. Support for operational automated systems is accomplished by a team assigned to the FAA Technical Center. Support for non-automated systems is provided by a team headquartered at the Mike Monroney Aeronautical Center. Logistics support is provided by the FAA Depot located at the Aeronautical Center.

Emergency communications are presently conducted via a network of high-frequency, single-sideband equipment. The network provides management of the capability for continuing or restoring operations in cases of severe weather, national disasters, and other losses of normal communications channels. It is also a means of non-secure backup communications of defense readiness situations. The local FM networks provide limited communications capability for routine and emergency requirements with remotely located maintenance personnel.

Support for environmental facilities is consistent with the general technology of FAA systems. There is still a significant amount of vacuum-tube technology which requires frequent maintenance and the provision of heating, ventilation, and air conditioning. In many cases, the electric power supporting this equipment necessitates the use of engine generators as backup power systems. Air conditioning, heating, and buildings are set up to provide an environment for the equipment as well as for the maintenance staff. In some remote areas, particularly in Alaska, the FAA provides employee living quarters and other public services.

The evolution of the NAS is greatly dependent upon the efficient use of the radio frequency spectrum.

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THE NEW APPROACH

Maintenance, flight inspection, and system support capabilities will be improved and modernized in support of efforts identified in the previous chapters. Modernization of maintenance and operation support systems of NAS will allow it to operate more efficiently, enable maximized system performance, and support the goals of reducing manpower and energy expenditures. The changing technology and the influx of new systems and capabilities, coupled with the need to provide uninterrupted air traffic control and air navigation services, require a planned evolution of supporting capabilities and equipment.

The Maintenance Program for the 1980s has been developed to address the evolutionary change in system maintenance. It is based on the following: implementation of solid-state technology, introduction of remote monitoring, control and certification, centralization of the work force, improved centralized repair facilities and decentralized training capability. The individual systems specialist will continue to be the most important link in system integrity. Maintenance automation aids, power systems, environmental systems, and structures improvements, in combination with the replacement of all vacuum-tube technology systems, will allow for increased productivity and decreased cost.

Instead of periodic preventive maintenance and frequent site visits, automated aids will allow FAA to monitor system performance continually from maintenance control centers. This will reduce travel requirements and cost. Also, by using remote monitoring techniques, the FAA can eliminate manning of many facilities and consolidate maintenance personnel into a relatively small number of centralized work centers without harm to service. Onsite corrective maintenance at remote locations will be limited to replacement of line replaceable units (LRUs). This will minimize both service restoration time and the requirement for costly test equipment at these locations. Due to the increased complexity of hi-tech modules, LRU repair will be performed at a high technology repair facility, which will be equipped with the necessary diagnostic and test equipment, and staffed by skilled personnel.

Elimination of staffing at remote facilities depends partly on the replacement of engine generators and removal of other systems that require onsite personnel. Facility consolidation and remote monitoring will allow sharp reductions in FAA-owned housing at facilities in isolated areas. Centralized technical training provided at the FAA Academy will continue to be augmented by computer-based instruction at field locations. Computer-based instruction will be particularly useful for proficiency training on the solid-state systems, air traffic recurrent training, and safety inspector training.

The FAA's flight inspection program will undergo a similar evolution. New technology, more fuel efficient aircraft, new system capabilities for automatic flight inspection, past consolidation of the work force, and policy changes will allow for orderly transition from the old to the new with no decrease in safety while reducing operating costs.

The FAA's system support has been geared to support the existing systems while a full-scale effort is underway to produce the capabilities required in the future. A system engineering and integration contract has been awarded which provides for management assistance and technical support for the implementation of the NAS Plan. The emergency command, control, and communication capability will be provided nationally with a radio network of HF and FM equipment.

Frequency engineering and management is a critical activity to assure interference-free operation of the many FAA facilities. Electromagnetic compatibility aspects make close monitoring of frequency assignments a must.

Two major laboratories located at the FAA Technical Center will be upgraded for use in the testing and evaluation of new systems prior to and during field use. The system support laboratory (SSL) will be used for: direct assistance to field facility technicians; development and testing of systems; hardware, software, and firmware modifications; and support of new development activities. The general support laboratory (GSL), consisting of general purpose systems, facilities, and aircraft, will support the SSL.

HOW THE SYSTEM WILL EVOLVE

INITIAL EFFORTS (TO 1985)

Efforts through 1985 have focused on assuring continued reliable operation and providing a solid foundation for future-year improvements. There have been accomplishments in all categories and projects. Some of the more significant achievements for this period are highlighted below.

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Remote maintenance monitoring (RMM) and control efforts are well underway. Almost all VORs and VORTACs have been replaced with RMM-compatible equipment. Thirty-three maintenance processors have been purchased and installed. Testing and evaluation of operational hardware, software, and concepts are being accomplished.

Initial operational requirements for the maintenance control centers have been defined and a general NAS (GNAS) prototype established. Four hundred and twenty-nine computer-based instruction terminals have been acquired and installed to provide technical and proficiency training in the field.

Airport selection criteria for installation of large airport cable loops have been completed and power system standards development is well underway. The installation of a prototype cable loop system has been completed.

Power conditioning systems for ARTS IIIs have been installed at the higher-priority locations. Power system improvements such as lightning surge protection and improved grounding, bonding, and shielding are being accomplished before solid-state equipment is installed. Engine generator refurbishment, replacement in-kind, replacement with battery backup systems and line conditioning equipment have begun.

Unmanned facility evaluations and improvement program plans have been completed as are the first facility standard designs. Sixty AFSS sites have been selected. Over half have been completed or under construction.

The number of Airway Facilities sectors has been reduced to 82 from 115 in 1981.

Flight inspection field office consolidation has been accomplished. Seven locations have been reduced to five. A Boeing 727 simulator and five portable flight inspection systems have been obtained and are in use.

A system engineering and integration contractor has been acquired who is providing the FAA with program management, project management, and technical support.

Within the system support laboratory FSAS Model 1, NADIN IA, FDIO, and host systems have been installed.

NEAR TERM (TO 1990)

During this period many of the individual projects will be completed or near completion. The remote maintenance monitoring system (RMMS) and maintenance control centers (MCC) will result in substantial benefits. All of the maintenance control centers will be operational, serving as the nerve center of the maintenance function. CBI expansion will be completed. It will allow for less centralized training, specifically in the proficiency training area. Airport cable loop installations will be completed at those priority locations identified by the regions. Power conditioning systems for all ARTS III systems will have been provided. Major structural, heating, ventilation, and air conditioning modernization work will be underway at nearly all ARTCCs and many unmanned facilities.

The sectors will provide some repair of modules and replacement of failed parts. Repair of hi-tech and difficult-to-repair items will continue to be accomplished at the FAA Depot.

Environmental RMM for HVAC, power systems, and unmanned facilities will be well underway allowing reduction in site-visit frequency. Buildings which house the automated flight service stations will have been acquired either through lease or construction.

The number of Airway Facilities sectors will have been reduced from 81 in 1986 to 75.

Aircraft and flight inspection upgrades will continue. Semiautomatic flight inspection will be eliminated and its function incorporated into an automatic flight inspection program. The fleet will be replaced by turbine-powered aircraft providing significant operating cost reduction. The number of flight inspection operations hours will be reduced from 27,000 hours annually in 1981 to 20,000 hours by 2000. In 1986 a contract was awarded for fuel efficient, light, turboprop aircraft that will significantly reduce flight operating costs. Mission-ready aircraft and updated flight inspection instrumentation will be in use for global and domestic service. An emergency communication network will be in place as a result of interfacing the backbone network with the eastern and western command networks and regional FM networks.

Support laboratories at the FAA Technical Center will be upgraded in keeping with the establishment of new systems in the NAS.

LONG TERM (TO 2000)

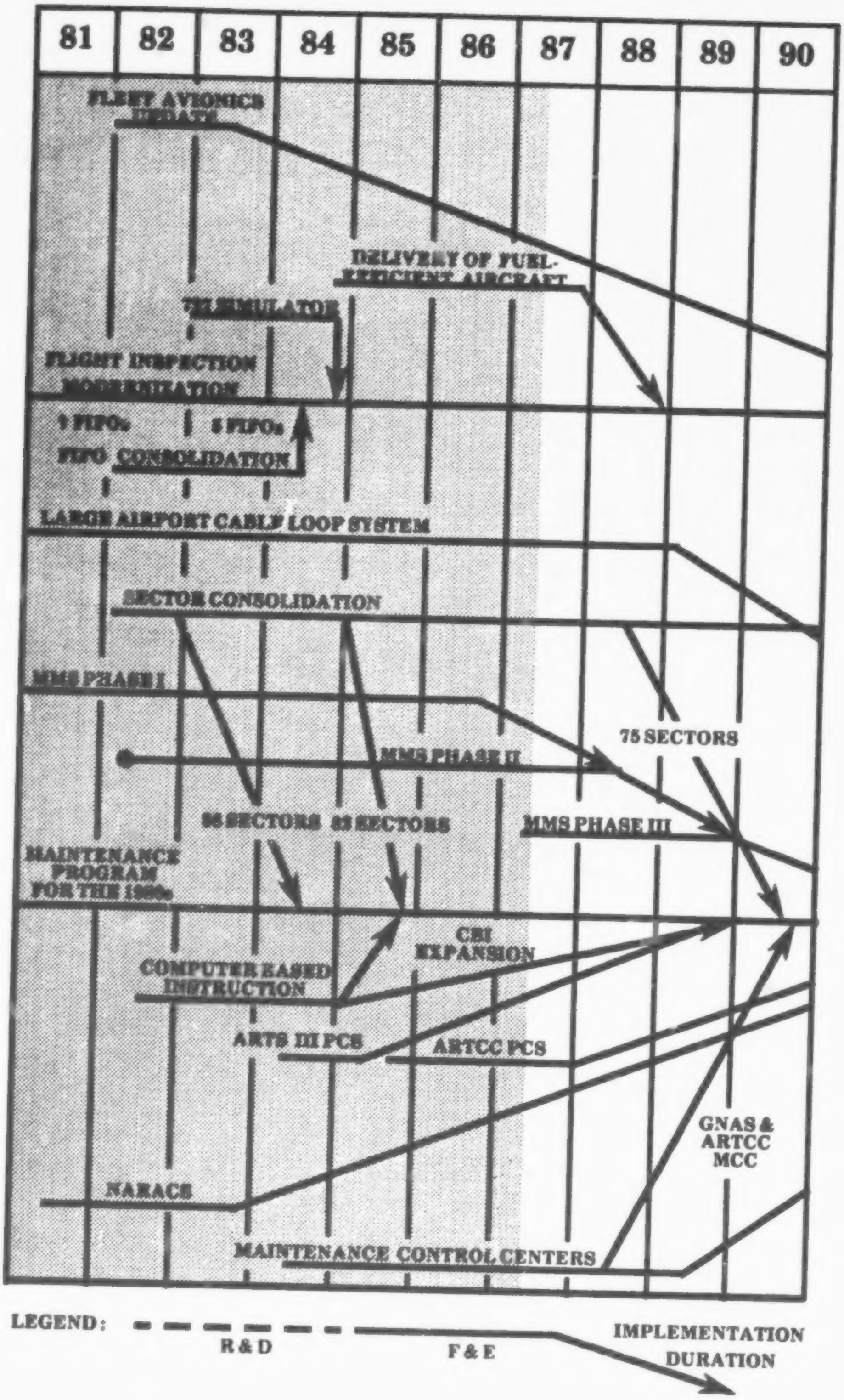
The Maintenance Program for the 1980s will be implemented by mid 1990s. The RMM system and MCCs will be operational. The number of sector offices will be reduced to 65.

The currently planned power and structures improvements will have been completed. More reliable cable loop systems will serve large airports.

The system engineering and integration contract extension options will expire in 1994. At that time, the originally identified NAS Plan projects should be substantially complete.

The support laboratories, both systems and general, will be focusing more on installed system modification and improvements instead of initial tests and evaluation.

The following diagram and maps describe the evolution of the system.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SIMULATOR
FLIGHT INSPECTION MODERNIZATION
FIFOs
FIFOs
FIFO CONSOLIDATION
LARGE AIRPORT CABLE LOOP SYSTEM
SECTOR CONSOLIDATION
MMS PHASE I
75 SECTORS
MMS PHASE II
SECTORS
SECTORS
MMS PHASE III
MAINTENANCE PROGRAM FOR THE 1980s
CBI EXPANSION
COMPUTER BASED INSTRUCTION
ARTS III PCS
ARTCC PCS
GNAS & ARTCC MCC
NARACS
MAINTENANCE CONTROL CENTERS
LEGEND:
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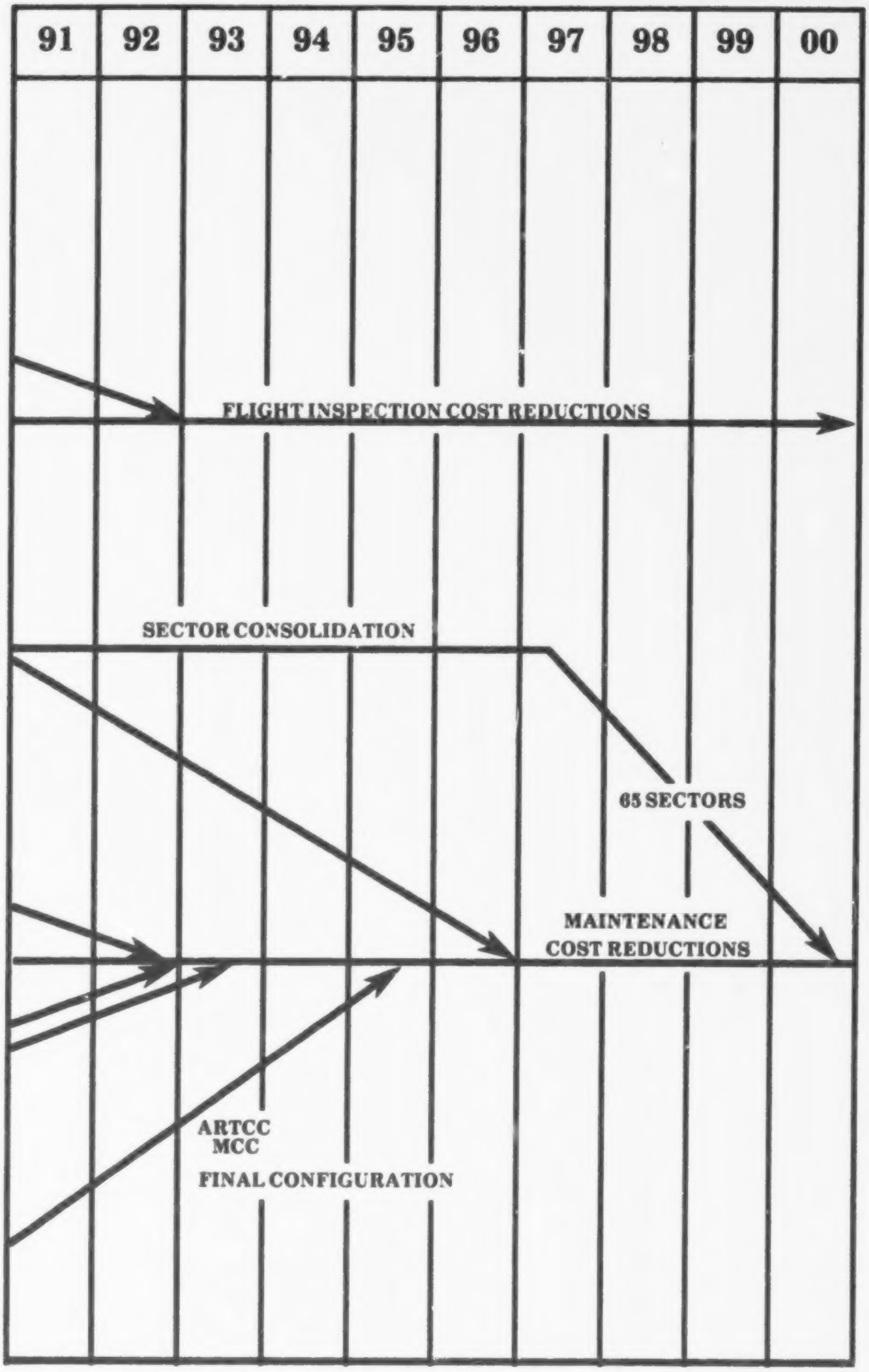

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS EVOLUTION

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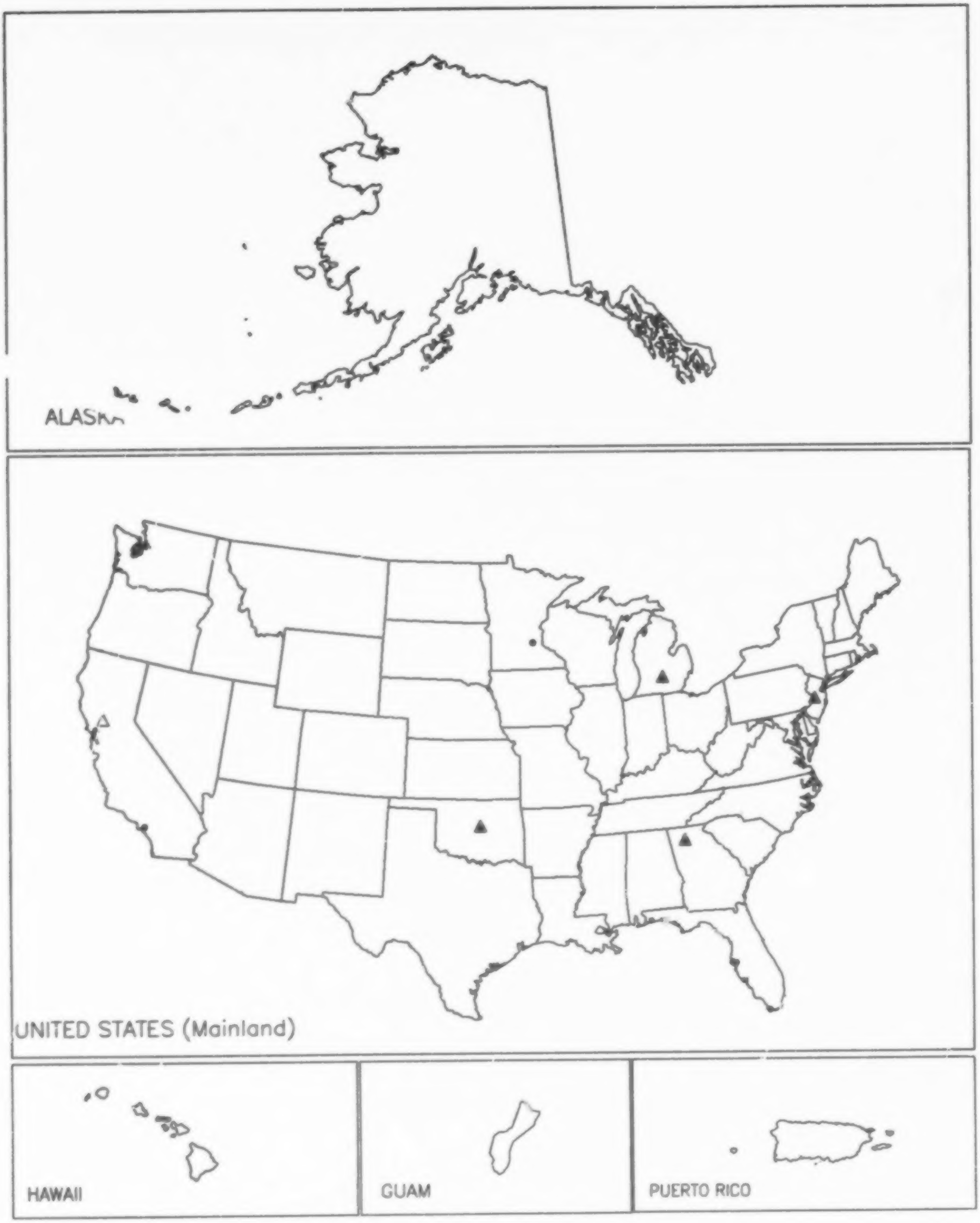
THIS MAP INDICATES THE OFFICE LOCATIONS FOR THE SEVEN FLIGHT INSPECTION FIELD OFFICES EXISTING IN 1981 AND THE CURRENT LOCATIONS FOR THE FIVE FLIGHT INSPECTION FIELD OFFICES AFTER CONSOLIDATION IN 1984.

● **1981 FLIGHT INSPECTION FIELD OFFICES**

△ **1986 FLIGHT INSPECTION FIELD OFFICES**

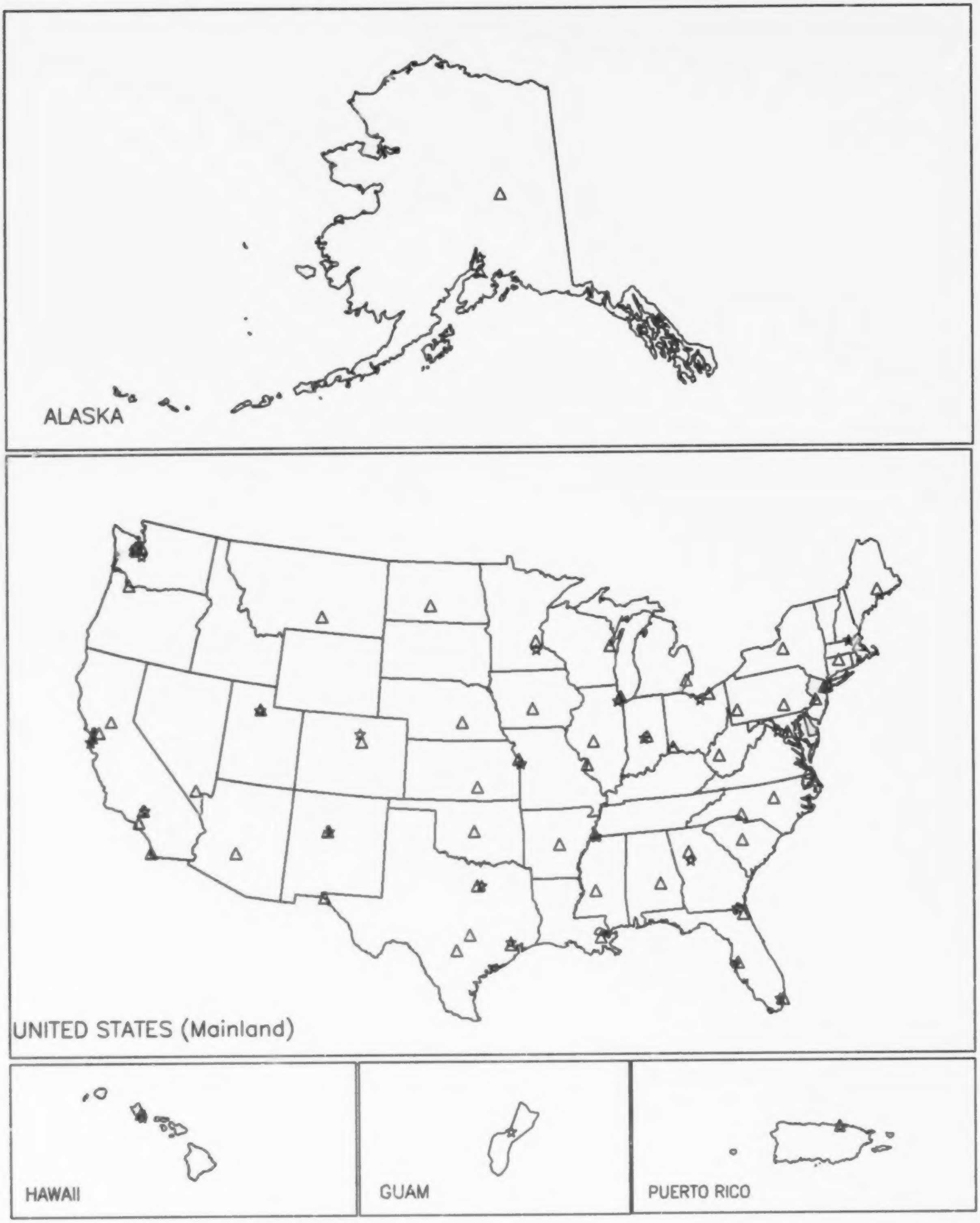

ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

FLIGHT INSPECTION FIELD OFFICES

THIS MAP SHOWS THE LOCATIONS OF THE 81 AIRWAY FACILITIES SECTOR OFFICES. THE REDUCTION FROM 115 SECTOR OFFICES IN 1981 IS A RESULT OF CONSOLIDATION THROUGH 1986. CONSOLIDATION OF AIRWAY FACILITIES SECTOR OFFICES WILL REDUCE LOCATIONS TO 75 BY 1990, AND 65 BY THE YEAR 2000.

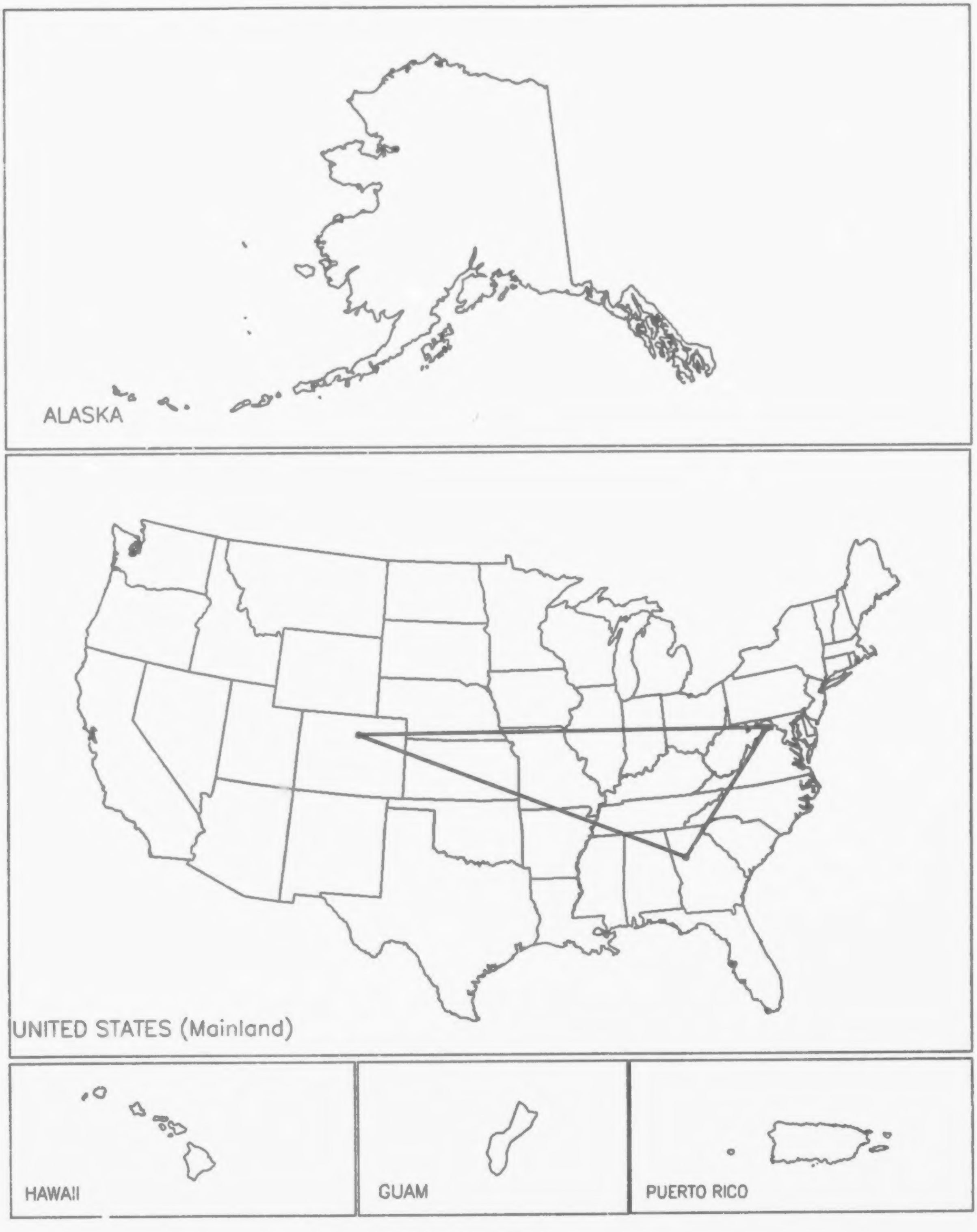
★ ARTCC SECTOR OFFICES

△ GENERAL NAS SECTOR OFFICES (INCLUDES NATCOM)


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1986 AF SECTOR OFFICES

THIS MAP SHOWS THE SIMPLE VOICE HIGH-FREQUENCY BACKBONE NETWORK IN 1981. PRESENTLY, THE BACKBONE NETWORK HAS NODES AT THE FAA COMMUNICATIONS CONTROL CENTER AND THREE NATIONAL EMERGENCY OPERATIONS FACILITIES.


ALASKA
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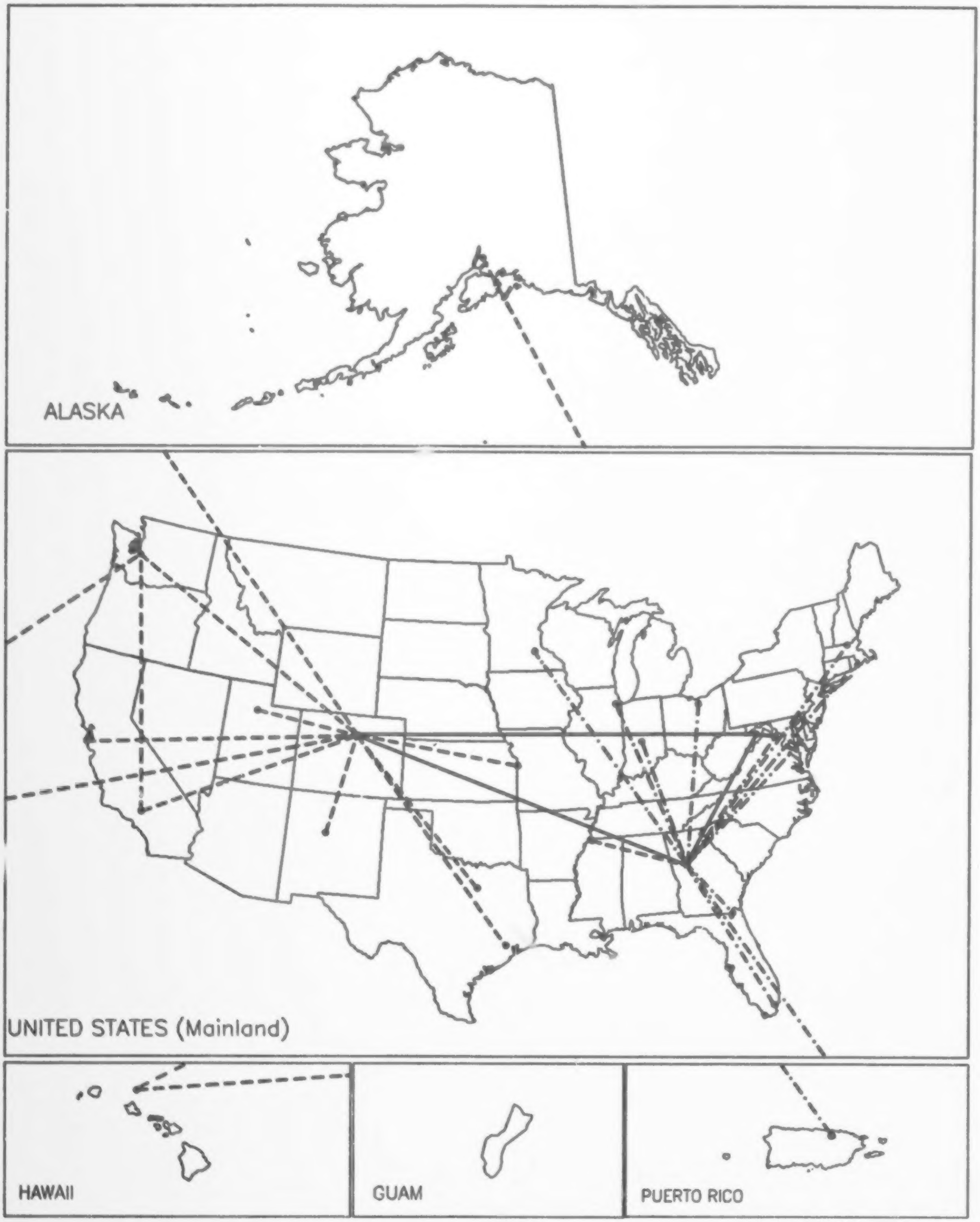
HAWAII
GUAM
PUERTO RICO

1981 SYSTEM
NATIONAL EMERGENCY COMMUNICATIONS SYSTEMS

THIS MAP SHOWS THE EASTERN AND WESTERN NETWORKS COMBINED WITH THE BACKBONE HF NETWORK TO FORM THE NATIONAL RADIO EMERGENCY COMMUNICATIONS SYSTEM. ANCHORAGE HF/SSB RADIO WILL BE UPGRADED TO BE AN EXTENSION OF THE BACKBONE NETWORK. RADIO LINKS WILL BE PROVIDED TO INTERFACE THE REGIONAL NETWORKS TO THE HF NET.


ALASKA
UNITED STATES (Mainland)
HAWAII
GUAM
PUERTO RICO

1990 SYSTEM
NATIONAL RADIO COMMUNICATIONS SYSTEM (NARACS)
(HIGH FREQUENCY SYSTEM)

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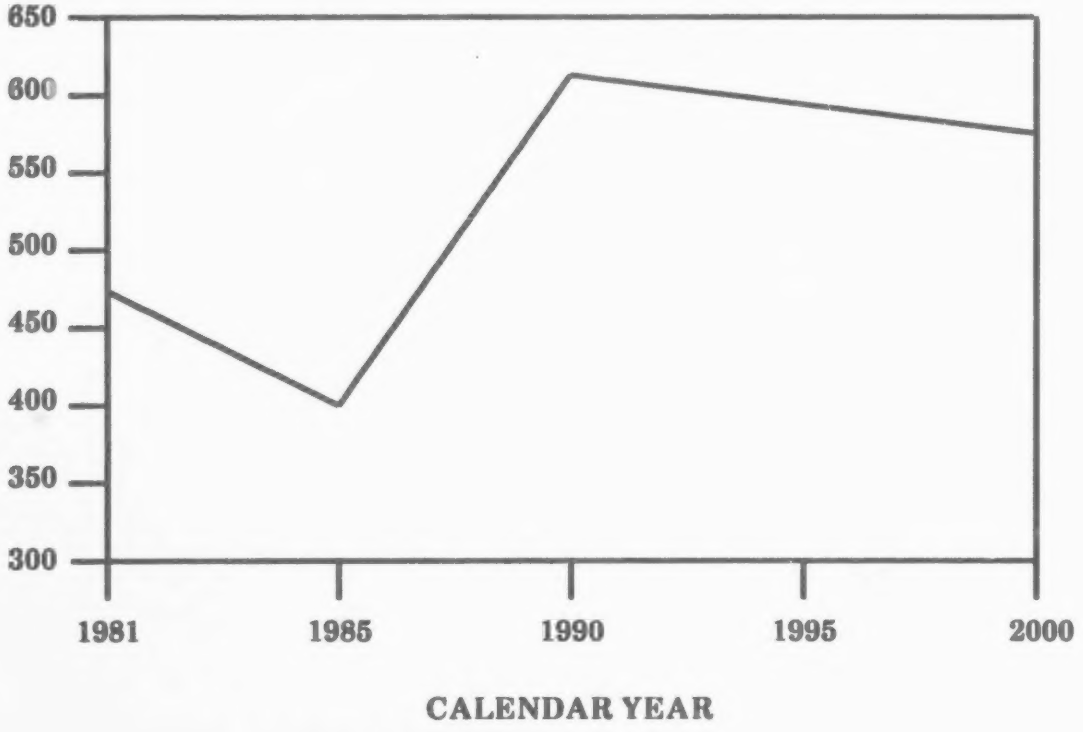
RETURN ON THE INVESTMENT

As a result of improvements to maintenance operations, power systems, structures, aircraft, and facility consolidations, the FAA will be able to provide a variety of new and improved services with significant reductions in both overall staffing and total operating costs.

FIELD EMPLOYMENT

During the next 13 years, the maintenance and operations support system will undergo significant changes in hardware and plant improvements which will result in a more efficient maintenance work force. The apparent increase in staffing for the maintenance operations and support system beyond 1985 is primarily due to the implementation of RMMS and maintenance control centers. Although manpower requirements increase in the programs covered here, the overall Airway Facilities staffing reflected in other chapters of the Plan will show a marked decrease due, in large part, to the implementation of the remote maintenance monitoring concept. MCCs are the nucleus of the remote maintenance monitoring system.

Employment levels shown below reflect Airway Facilities sector manager and subordinate positions required to staff the maintenance and operations support system. Air Traffic, FAA Academy, and national field support group staffing are not included in this data.



AIRWAY FACILITIES EMPLOYMENT
(MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS)

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SUMMARY OF FACILITY CHANGES

1981 - The employment level supporting the maintenance and operations support program was 473.

There were 115 AF sector offices in operation.

1985 - Staffing has been reduced to 401. The reduction is a result of replacing engine generators with batteries at facilities that have had vacuum tube equipment replaced with solid state, and reduction in the number of site visits required to maintain the facilities.

1990 - Staffing levels will increase to 607 to provide 24-hour coverage for the ARTCC maintenance control centers. Remote maintenance monitoring and control functions will be consolidated at the MCCs, allowing an overall decrease in total maintenance staffing requirements.

AF sector offices will be reduced from 82 to 75.

2000 - Staffing levels will decrease to 575. Fully implemented RMM and MCC facilities, in conjunction with the completion of solid state equipment replacement and facility consolidations, will result in an overall reduction in AF staffing from 10,818 in 1981 to 7,735 in the year 2000.

AF sector offices will be reduced to 65.

Outyear estimates are reviewed annually and are subject to revision.

MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS AIRWAY FACILITIES EMPLOYMENT CHANGES AND CORRESPONDING PERSONNEL COSTS

	1981	1985	1990	2000
Operations (Millions)	151.5	143.5	153.7	185.7
Airway Facilities Personnel	473	401	607	575
AF Productivity Quotient	320,296	357,855	253,213	322,957
Airway Facilities Personnel Costs (Thousands)	$16,129	$13,674	$20,699	$19,608

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PROGRAM RELATIONSHIPS

The 18 projects in this chapter comprise an integrated program to modernize or sustain the physical facilities, core equipment, and supporting functions which are essential to the cost-effective maintenance and operation of the National Airspace System. Modernization of the National Airspace System, as described in the previous chapters, requires that corresponding improvements be made to the manned and unmanned physical structures which house new or retained equipment and the power sources which enable them to operate. Supporting functions, including maintenance, engineering, and flight inspection and testing, similarly require capital investment to ensure successful implementation and maximize potential cost savings. The projects are grouped into five basic improvement categories: maintenance, power, structures, aircraft, and system improvements.

Maintenance improvements in the form of the remote maintenance monitoring system and maintenance control centers will allow for the implementation of the 1980s maintenance concept, which provides for remote monitoring of new and retained equipment, automated record keeping, and improved utilization of the maintenance work force. Facility performance will be assured at maintenance control centers which will be the nerve center of systems maintenance. Training of technical, operations, and safety personnel will be improved by the expansion of computer-based instruction.

Power improvements involve nearly every facility in the FAA inventory by improving grounding and lightning protection, replacing engine generators with batteries, providing power conditioning systems, or installing more reliable power and signal distribution systems in the form of airport cable loops.

Buildings and structure improvements deal with the refurbishment and modernization of manned and unmanned FAA facilities. Improvement of roads; parking areas; building interiors and exteriors; and heating, ventilation, and air conditioning account for the majority of activity in this section. Other efforts include the acquisition of AFSS buildings.

Aircraft improvements provide for replacement of obsolete aircraft with modern fuel-efficient aircraft. In support of projects in other chapters, this will reduce flight inspection costs and add new avionics equipment to the FAA aircraft fleet to keep pace with system improvements and addition of new services.

System improvements encompass support activity for the NAS such as general support activity, frequency spectrum engineering and management, NAS system engineering and integration assistance, and the upgrading necessary for the general and support laboratories. The national radio communications system is included which will provide emergency command and control communications capability without need for land lines.

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PROJECTS	IMPLEMENTATION	
	FIRST	LAST
MAINTENANCE IMPROVEMENTS		
1. Remote Maintenance Monitoring System (RMMS)	1980	1992
2. Computer Based Instruction (CBI)	1982	1989
3. Central Repair Facility (CRF)	PROJECT	DELETED
4. Maintenance Control Center (MCC)	1985	1995
POWER IMPROVEMENTS		
5. Large Airport Cable Loop Systems	1989	1996
6. Power Conditioning Systems for Automated Radar Terminal Systems III (ARTS III)	1985	1989
7. Power Systems	1981	1992
STRUCTURES IMPROVEMENTS		
8. Unmanned FAA Airway Facilities Buildings and Plant Equipment	1983	1992
9. ARTCC Plant Modernization	1984	1993
10. Acquisition of Flight Service Facilities	1982	1989
AIRCRAFT IMPROVEMENTS		
11. Aircraft Fleet Conversion/Flight Inspection Modernization	1982	1988
12. Aircraft and Related Equipment	1983	1992
SYSTEM IMPROVEMENTS		
13. System Engineering and Integration Contract	1984	1994
14. National Radio Communications System (NARACS)	1983	1993
15. NAS Spectrum Engineering	1982	1992
16. General Support	1982	1992
17. System Support Laboratory	1983	1993
18. General Support Laboratory	1983	1992

PROJECT SUMMARY

PROJECT 1: Remote Maintenance Monitoring System (RMMS)

Purpose: This program will provide a system to enable the FAA to automate its maintenance operation. It will provide monitoring and control equipment for selected FAA facilities so that equipment performance monitoring, control, and certification can be accomplished from centralized work centers. Remote maintenance monitoring will permit staffing reductions and consolidation, improve quality of worklife, improve work force utilization, and increase work force productivity. When fully implemented, remote maintenance monitoring will permit substantial savings in operations cost and manpower.

Approach: Implement the RMMS in an evolutionary fashion to assure a smooth transition from present maintenance operations into the operational scenarios of the Maintenance Program for the 1980s.

Remote Monitoring Subsystems (RMSs) will be employed to collect, store and transmit performance data and to provide the means to remotely adjust, certify, and/or reconfigure the facilities. Current systems without RMM capabilities will be equipped with RMSs according to the needs of the maintenance workforce.

RMS Concentrators (RMSCs) will collect data from a group of RMSs, typically at airports, for transmission to the control and monitoring locations. RMSCs will be placed where it is cost-beneficial to reduce leased communications costs. It is estimated that up to 750 concentrators will be required to complete the total end-state RMM network.

Maintenance Data Terminals (MDTs) provide the means for the sector workforce to access the RMM network. Portable MDTs will be provided to access RMSs and the network from remote sites. Fixed MDTs will be provided at Sector Offices, work centers, and Maintenance Control Centers. MDTs will be procured in two phases: Initial quantities of approximately 1200 will be bought in FY-87 to establish the basic system capabilities. Additional MDTs will be purchased from FY-88 through 91, as system needs dictate, for final configuration.

Maintenance Processor Subsystems (MPSs) have been installed at all ARTCC and 10 GNAS Sectors to process, store and route facility data to and from Maintenance Data Terminals. MPSs will be upgraded and enhanced as capacity and speed requirements dictate.

Monitoring/Control Software (MCS), running in the MPSs, will provide the primary facility monitoring and control functions. Interim MCS (IMCS) software is currently installed in all MPSs, and will be utilized until MCS becomes available. MCS procurement specifications are being defined to permit deployment beginning in 1988.

Maintenance Management System (MMS) software will be provided (to run concurrently with MCS in the MPSs) to permit the use of facility data at sectors, work centers, regional offices, and FAA support organizations. MMS will be implemented in three phases: Phase 1 (in final testing) provides the basic information gathering functions, such as automated facility logs, performance reporting, preventive maintenance scheduling, and a facility, service, and equipment profile data base. Phase 2 (under development) will add additional record keeping functions, such as facility modifications, inspections, configuration management, energy management, and personnel training and certification. Phase 3 will provide MMS enhancements, such as performance analysis and failure anticipation.

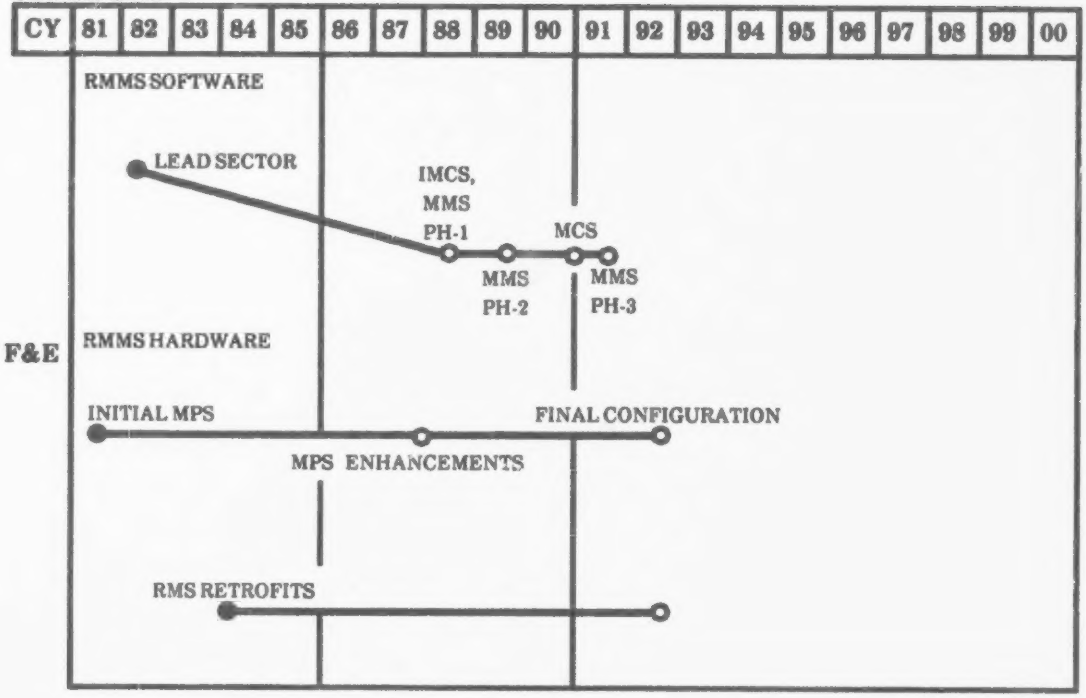
Products:

- RMMS Software - Initial and final monitor/control software, and maintenance management system software in three phases.
- RMMS Hardware - 38 MPSs at ARTCC, GNAS and field support sectors; up to 750 RMSCs; up to 4000 MDTs.
- RMS Retrofits - For ARSR, ATCBI, CD, ILS, and other facility types as justified.

Related Projects/Activities:

The establishment of remote facility monitoring and control from central locations will require coordination and interfaces with all NAS Plan activities, the most significant being: MCC, program offices with RMS requirements, Maintenance Processor Subsystem (MPS) Enhancements, the Advanced Automation and ACF projects, and all Interfacility Communications projects.

SCHEDULE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RMMS SOFTWARE
LEAD SECTOR
IMCS, MMS PH-1
MMS PH-2
MCS
MMS PH-3
F&E
RMMS HARDWARE
INITIAL MPS
FINAL CONFIGURATION
MPS ENHANCEMENTS
RMS RETROFITS

PROJECT 2: Computer Based Instruction (CBI)

Purpose: This project will result in an expansion of the present program of standardized high-quality, cost-effective training of FAA personnel at decentralized work locations. CBI provides developmental training in Air Traffic and Airway Facility field locations. Enhanced proficiency training based on individual needs and requirements will also be provided for Airway Facilities, Flight Standards and Air Traffic employees. Proficiency training, always a formal Air Traffic requirement, is also now required by Airway Facilities because of the high reliability of the new equipment and the new maintenance philosophy. Where possible in Airway Facilities, CBI will be used at local or field sites and will form the nucleus of field-conducted training. In other cases CBI will be coupled with hands-on equipment training at the FAA Academy. Simulations permit an increase in learning apart from the actual equipment.

CBI promotes the accomplishment of the agency mission by:

- Significantly reducing the current travel costs associated with centralized training.
- Improving the efficiency and productivity of existing facility training staffs.
- Providing flexibility in scheduling and conducting training according to the individual's and facilities unique needs.
- Allowing for greater local management control of the training schedules and resources.
- Making standardized onsite proficiency/update training more available.
- Fostering improvements in employee productivity.

Approach: Establish CBI learning centers with hardware/software, courseware where there are concentrations of field personnel. Additionally, existing hardware/software will be upgraded.

During 1981-1983, a limited number of Airway Facilities courses were developed and provided at 60 field locations. Additional high-volume technical training became available in 1984 and 1985. Other courses will be available in 1986 and 1987 at Airway Facilities and Flight Standards field offices.

Air Traffic currently has over 250 lessons in the field for use in the en route and terminal options with more planned for 1987 and 1988.

The computer based instruction terminals now interface with a CYBER mainframe computer at a facility provided by the U.S. Army at Redstone Arsenal as part of an intergovernmental software support system. This is accomplished using some new and some existing leased circuits via an FAA multiplexing modem network. This approach is significantly less expensive than procuring additional leased circuits for each terminal.

Additionally, considerable telecommunications costs have been avoided in the Air Traffic CBI program because the majority of the courseware is suitable for delivery in an off-line mode using disk drives. Lines are used only to transfer student records or other training information. The Airway Facilities CBI program requires the greater capacity of the on-line CBI system, but future technology may make this capability available in an off-line format.

Products: By 1985 there were a total of 429 CBI terminals accompanied by disk drives at 182 locations. Printers were provided at each location.

• Airway Facilities sector offices	131
• Flight inspection offices	7
• ARTCCs	150
• Airport Traffic Control Towers, Levels IV & V	83
• FAA Academy	46
• Regions/centers/Washington headquarters	12

By 1987, 218 terminals with disk drives are required for 109 Level III Airport Traffic Control Towers. In 1988, terminals are required for 159 Level II Towers and for 61 Automated Flight Service Stations. A substantial training workload exists at the lower level towers while training staff is nonexistent. The ongoing operational needs preclude dedication of staff to perform required proficiency training.

This training impact is also experienced at the larger towers whose staff requirements are most often met by moving staff from lower level to higher level facilities. Additionally, CBI terminals will be provided to all automated flight service stations. Because of the numerous AFSS operational changes, training requirements have escalated, with no increase in training staff. The CBI units will assist us to fill that gap.

• Airport Traffic Control Towers, Level III	218
• Airport Traffic Control Towers, Level II	159
• Automated Flight Service Station	61

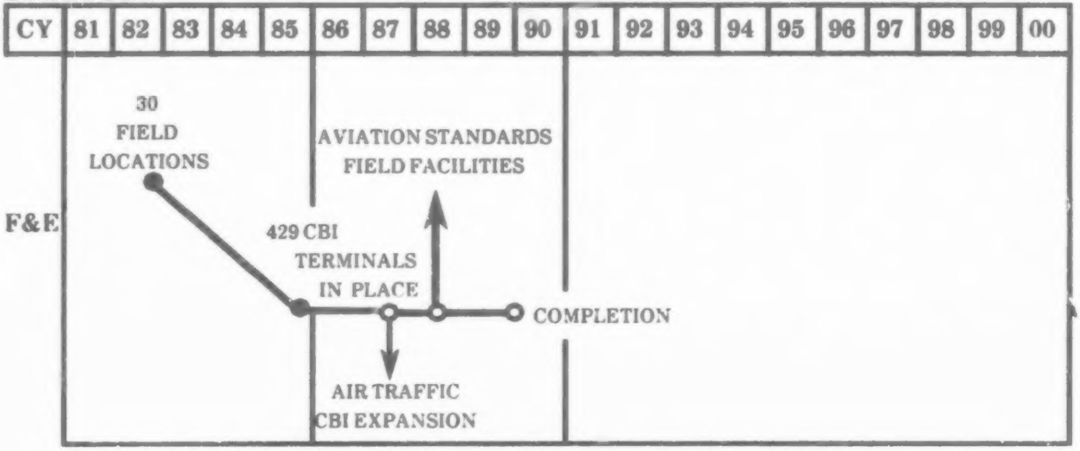
In 1988, 100 CBI learning stations are planned to improve safety inspector training in Aviation Standards field facilities. The requirement is in accordance with Project SAFE (Safety Activity Functional Evaluation) and addressed in the comprehensive review, a Blueprint for Flight Standards. Project SAFE is a product of a Secretary of Transportation initiative. CBI will deliver local recurrent/update training requirements.

• Aviation Standards	89
• Washington Headquarters	1
• FAA Academy	10

This add-on is anticipated to be available in the field during late 1989 and early 1990.

Related Projects/Activities: With the many technological improvements being made in the computer based instruction field and other innovative methods of instruction being developed, a continuing study of these changes is being conducted by the Office of Personnel and Technical Training (APT), each service and the Aeronautical Center (AAC). We anticipate the need to upgrade each CBI training center at a minimum of 7-year intervals. This project will require interfacility communications service from NICS. Projects providing service include Data Multiplexing and RML Replacement and Expansion. Chapter 7 contains the requirements for system expansion/enhancements for the period 1989 through 1992.

SCHEDULE



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PROJECT 4: Maintenance Control Center (MCC)

Purpose: This project will provide maintenance control centers (MCC) which will be the nerve centers for monitoring facilities in a specific jurisdictional area. Should failures occur, the MCC will initiate corrective action through the RMMS and notify the work force by telephone or by the regional FM communication network (an integral part of NARACS). The MCCs will also serve as centers for communications and coordination during emergency situations (natural/defense/accident) as well as the primary interface between ATC operations and maintenance/support activities. In the final configuration, the MCC at the ARTCC will serve as the focal point for maintenance and operations support of the automation and communications subsystems co-located at the center. This final system will be the result of an evolutionary process incorporating the monitoring of new subsystems as they become part of the National Airspace System.

Approach: Lead sector studies were completed which established the initial procedures and requirements for MCCs at ARTCC and GNAS sectors.

Two projects are planned to provide centralized monitor and control capabilities:

- ARTCC MCCs will be established to enhance NAS performance monitoring and service restoration. The existing Systems Maintenance Monitor Console will be replaced with an integrated workstation to consolidate the monitoring devices already deployed. The workstation will be augmented to incorporate the monitoring functions of new subsystems as they transition into the NAS. A prototype system was deployed to Atlanta in December 1985.
- GNAS MCCs will be established at each sector to provide a central focus for the facility restoration activities. The primary workstation equipment will be provided under the RMS project.

The MCCs will be equipped with the necessary workstations, processing capability, interfaces and voice communications capabilities to perform monitor and control functions. The final configuration of each MCC will depend on the number of facilities being monitored and other sizing considerations. The MCC will receive and process alarm and status information from remote facilities as well as co-located facilities. Processed data (status reports and/or alarms) will be displayed to specialists at this central location. These specialists will be able to take action as appropriate via the remote maintenance monitoring system or co-located automation and interfacility communication systems.

Products:

- ARTCC MCC - A prototype was completed in 1985; production units will be deployed to CONUS ARTCCs, the FAA Technical Center and the FAA Aeronautical Center by 1990.
- GNAS - MCCs will be established at each GNAS sector to focus the RMM capabilities.

Other products include the establishment of uniform functions and operating procedures, consistent training and space requirements, and the ability to direct and utilize the technical work force effectively.

Related Projects/Activities: The establishment of remote facility monitoring and control from a central location will require interfaces and coordination with all NAS program activities as they are scheduled to transition into the NAS.

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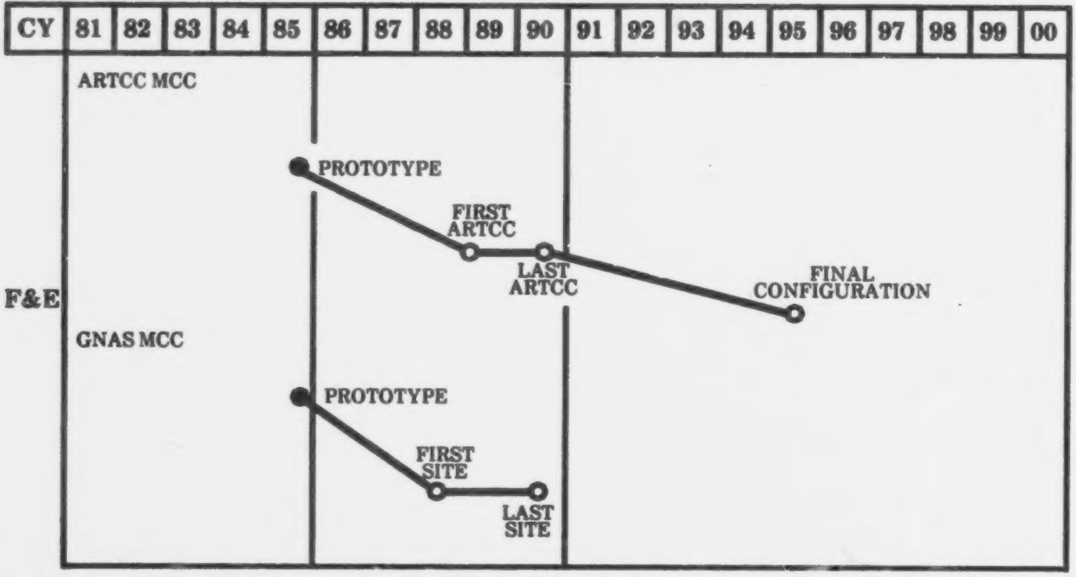
SCHEDULE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PROJECT 5: Large Airport Cable Loop Systems

Purpose: This project will establish a reliable and flexible power and/or signal distribution system at approximately 100 activity Level III, IV and V airports. Airport power and signal distribution must be viewed as a system rather than a loose collection of individual facility cables.

Many new establishment or modernization projects requiring large amounts of cable are in progress. Also, cables at many airports are 25 to 30 years old and are approaching the point where replacement is necessary for reliable operation. Reliable power and/or signal distribution, utilizing fiber optic or other technology, will be provided through the provision of new or the upgrading and replacement of deteriorated cables at major airports and the reconfiguration of them into loop systems.

The reconfigured cable network distribution will:

- Eliminate outages caused by deteriorating or failing cables.
- Allow cable repair with minimum outage time.
- Provide for better planning of airport cable systems.
- Minimize the number of small engine generators.

Additionally, fiber optic or other technology installation will:

- Provide for greater capacity than metallic conductor cables.
- Permit system growth with minimal additional cables.
- Eliminate cable damage from lightning surges.
- Reduce electromagnetic interference.

Approach: Each region will develop a master plan for the cable systems for those major and intermediate activity level airports qualifying on a cost-benefit basis. The master plan will provide for the replacement of deteriorated cables as well as installation of new cable in conjunction with major construction and facility establishment. New cable installations will be designed to provide for future growth and capacity.

Fiber optic cable compatibility with power cable allows for placement in the same trench or ducts and provides for a cost-effective installation. Fiber optics cable may be utilized with RMM.

Outage time resulting from cables damaged accidentally by animals or environmental factors will be minimized through fault sensing and switching of power, communication, and control cables.

An engineering analysis will determine the cost versus benefits of establishing the system scheme (loop network configuration) in comparison with the current approach of replacement in-kind and establishment of individual facility cables.

Products:

- More reliable and flexible power and/or signal distribution systems at 100 airports.
- Power system standards.

Related Projects/Activities: Planning for each airport will include the power, control, and communications needs since there are obvious benefits in providing cable ducts or direct earth burial concurrently. Noise and external interference will be minimized by proper spectrum engineering. Cost avoidance is also possible by coordinating the cable loop activities with other airport construction, either by FAA or airport management, such as MLS installations and runway extensions. Loop switching devices will have RMM capability. The Airport Telecommunications project is closely related as it provides the specifications and criteria for employing new-signal system technology such as fiber optics and RF data links.

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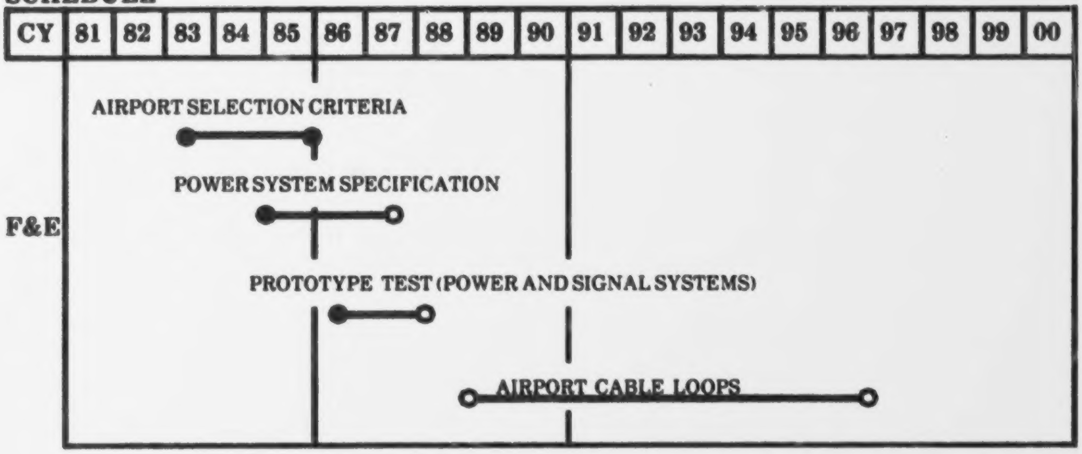
SCHEDULE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F&E
AIRPORT SELECTION CRITERIA
POWER SYSTEM SPECIFICATION
PROTOTYPE TEST (POWER AND SIGNAL SYSTEMS)
AIRPORT CABLE LOOPS

PROJECT 6: Power Conditioning Systems for Automated Radar Terminal Systems III (ARTS III)

Purpose: Medium- and high-activity terminals are provided with standby power that limits interruptions to a maximum of 15 seconds. However, the ARTS III equipment used at these locations is sensitive to small power transients and may go into a "save data" mode (frozen display) even when perturbations are not sufficiently long to require standby power. For standby power to be activated, the utility must be 10 percent below rated voltage for 2 seconds; whereas, ARTS III may go into a momentary "save data" mode if power is out of tolerance for 17 milliseconds. The ARTS IIIA may require 30 to 45 seconds to restore operation after return of acceptable power.

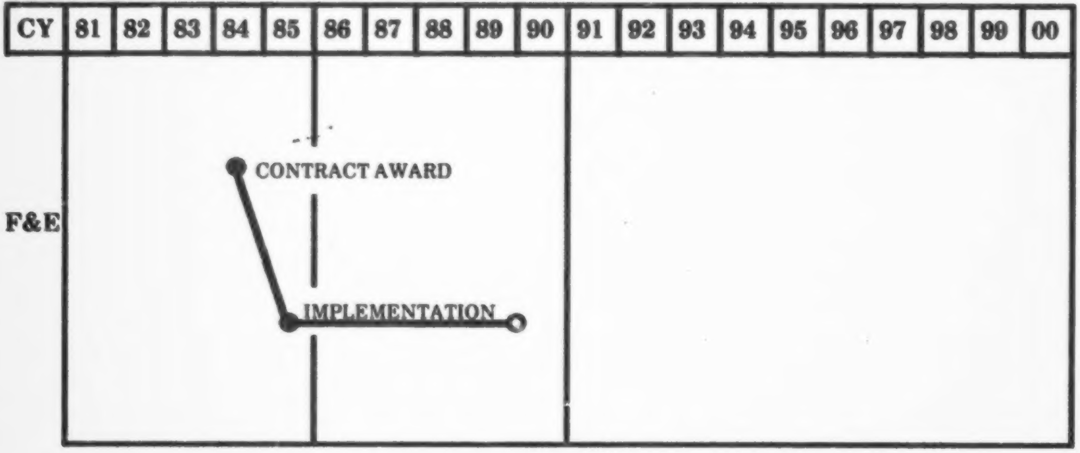
This program will increase the reliability of electrical power so that it will approach 100 percent availability. The installation of power conditioning systems (PCS) in the ARTS III facilities will increase operational reliability and reduce operational downtime.

Approach: Provide PCS to ensure that stable electrical power with precisely regulated voltage and frequency characteristics is continuously available for the operation of vital equipment. The equipment will be similar to the PCS/uninterruptible power system (UPS) currently located at offshore EARTS locations, the Atlanta aviation weather and NOTAM system (AWANS), and dual and triple RML facilities.

Products: 60 commercially available, off-the-shelf power conditioning systems.

Related Projects/Activities: None.

SCHEDULE



PROJECT 7: Power Systems

Purpose: This project will provide the optimum type and quality of electrical power necessary to ensure high facility availability and reliability and reduce operating costs and energy consumption of standby power systems at all major manned and unmanned facilities.

Standby power at unmanned facilities was almost entirely provided by engine generators. Vacuum tube technology imposed demands for standby power sources were best satisfied by engine generators. New electronics technology results in significant reductions in its energy consumption and related environmental support systems. New long-life batteries are now a practical alternative to small standby power engine generators. Battery standby power systems provide for increased facility availability, reduced operating costs, and reduced overall energy consumption. Also, recent technological advances in alternate power sources such as photovoltaics, fuel cells, and wind generators now offer a potential cost savings for prime power sources at locations when commercial power is not readily available. This program will accomplish the removal of replaced engine generators and the retrofit of existing facilities with battery standby power system, cost-effective alternate prime power system, and power conditioning equipment.

Many FAA structures and facilities do not have adequate lightning protection systems installed. In addition, some facilities have obsolete wiring and inadequate grounding, bonding, and shielding. Lightning surge protection devices must be improved at many facilities; and deficiencies in wiring, grounding, bonding, shielding, and code violations must be corrected.

In the future, most facilities will be unmanned and may normally be operated at lower temperatures in cold weather and higher temperatures during hot weather. Environmental RMS will save energy by adjusting temperature for manned operation during site visits only.

The modernization of critical power systems at major manned facilities is also part of this project. The power conditioning system (PCS) at ARTCCs is approaching the end of its predicted life and capacity limits. The system will require a major upgrade and possible expansion in order to continue to satisfy critical power requirements through and beyond the implementation of 23 planned area control facilities (ACF) at existing ARTCCs.

The method by which the PCS at the ARTCCs will be upgraded will be determined by a cost versus benefit study being conducted. The final system will be one which will increase the reliability of electrical power while providing for future load growth. The PCS at the offshore ARTCCs will be investigated and recommended improvements made to provide increased reliability.

Approach: Develop a national plan and criteria to improve power quality where required to satisfy facility mission requirements. Modifications will be made to standby power systems (replacement of small engine generators with batteries and dc distribution systems) and power transfer systems. Large engine generators will be overhauled or replaced. Remote maintenance monitoring systems will be utilized to permit monitoring, certification, and control. Approximately 2,000 smaller engine generators (30 kW and below) are in need of replacement with batteries and dc distribution systems as facilities are converted to solid state. Approximately 1,000 engine generators require overhaul or replacement. Other commercially available power sources will be introduced for use in the FAA.

Line conditioning, lightning surge protection and grounding, bonding, and shielding efforts will be continued to upgrade existing equipment to the latest state-of-the-art. Power conditioning devices will be provided to correct other known deficiencies. Replacement of obsolete wiring to meet code requirements will continue.

Products: Introduction of battery/dc distribution systems will enable removal (replacement) of the most critical of the approximately 2000 small-sized (up to 30 kw) engine generators. The most critical of approximately 1000 large engine generators will also be modified, refurbished, or replaced as required to maintain availability and quality of standby power service. Approximately 60 mobile engine generators (50 kw and above) will be provided to enable conversion to 80's maintenance concepts.

Approximately 550 line conditioning devices (battery systems/power filters/motor-generators/ uninterruptible power systems/etc.) will be provided, where required, to compensate for poor quality or reliability of available utility services.

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Approximately 1000 facility electrical systems will be modernized as required to support new solid-state electronic systems. This modernization encompasses upgrading facility lightning protection and grounding, bonding, and shielding systems, replacement of obsolete wiring and electrical devices to meet current national electrical code requirements, and electrical system improvements to provide optimum electromagnetic compatibility (EMC) between electronic subsystems and adequate immunity to electrostatic discharges. Approximately 50 percent of these facility electrical system modernizations will be required at large-scale facilities such as ARTCCs, ATCTs, ARSRs, and ASRs.

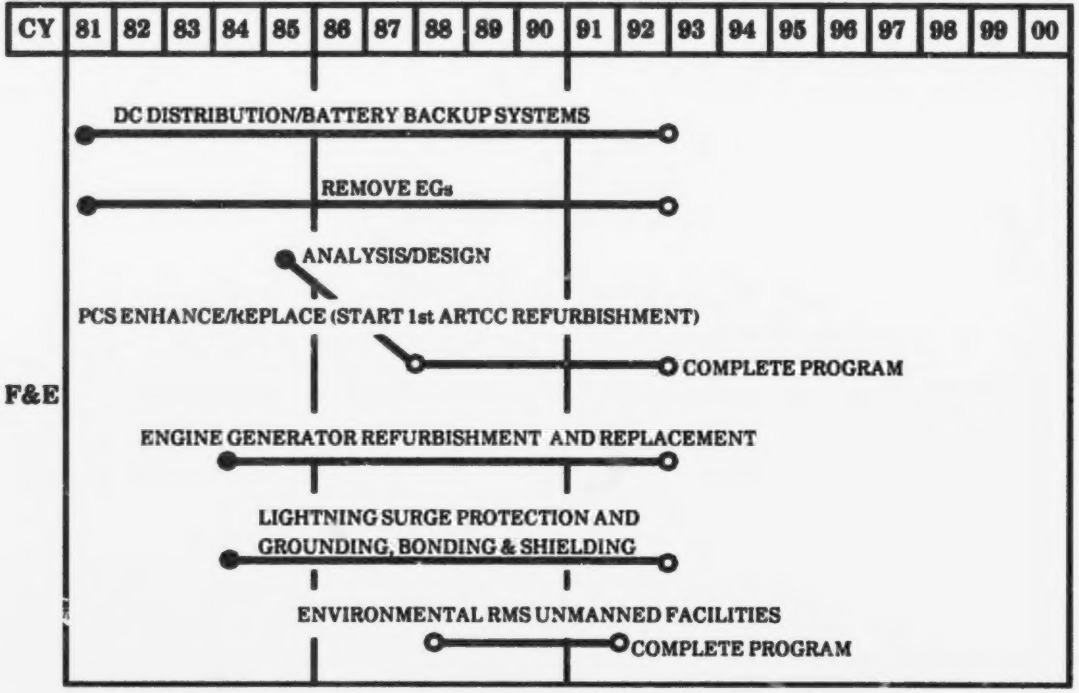
A refurbished or new critical power conditioning system (PCS) will be provided for the future ACFs (22 ARTCCs and the New York TRACON).

Related Projects/Activities: This project and the fuel storage tank effort described in Chapter 7 are designed to resolve the engine generator needs. Power systems requirements that are funded beyond 1992 will be accomplished under the Sustained NAS Support project, also included in Chapter 7.

The Unmanned FAA Airway Facilities Buildings and Plant Equipment project are also closely coupled. Electrical and environmental control system work described herein will be completed in consonance with the mechanical and facility modernization work described in the NAS Plan project titled Unmanned FAA Airway Facilities Buildings and Plant Equipment. Close coordination and common approach is also required with the ARTCC modernization program. Cost avoidance and minimized impact on the ongoing operation are the benefits.

Accomplishment of remote maintenance monitoring equipment installation concurrently will also be beneficial. Communication facility consolidation program may alter schedule and requirements, as may the final ACF configuration decision.

SCHEDULE



PROJECT 8: Unmanned FAA Airway Facilities Buildings and Plant Equipment

Purpose: This program develops new standards and upgrades existing buildings and plant equipment to provide adequate plant facilities for operation and maintenance of unmanned electronic facilities. These buildings house navigation, communications, surveillance, or landing systems.

Regions typically have accomplished facility improvement work with regional personnel or by individual contracts managed by the region. The work has been accomplished on an as-needed basis dependent on manpower and funding availability.

The large number of buildings approaching the end of their normal service life (generally 20 to 30 years) has created a need for a national program. It is quite probable that it will be more economical to replace some older buildings than to modernize them.

Approach: The practice of performing modifications according to the needs of the moment and tailoring these modifications to the requirements (climate, existing equipment mixes) reduces the degree of standardization between facilities. A systems approach will provide improved standardization and decreased support costs. A comprehensive national plan will be developed to provide new standards and implement modernization and improvement projects.

Many existing unmanned Airway Facilities buildings will continue to be used for the next 20 years. Much of the original electronic equipment installed in these buildings has been or will be replaced with a newer generation of equipment with environmental, size, and maintenance requirements that are substantially reduced. Appropriate modification will be made to adapt these facilities to the new equipment requirements and, thereby, reduce operational costs.

Modifications to repairable facilities will be made to keep the buildings in a usable condition through the year 2000. Modifications will include improvements to the buildings' weather tightness, installation of cost-beneficial insulation, and other changes for energy conservation.

Building modifications will be made to provide for co-locating navigation and communication systems at some sites. New standard designs will be developed for new facilities such as consolidated communications, ASR 9, ARSR 4, etc.

Tramways will be provided for safe, dependable access to mountaintop ARSRs and will reduce the need for costly road maintenance and specialized vehicles. There are four candidate locations where a tramway is considered economically justifiable.

Products:

- Standard facility designs will be provided.
- Approximately 150 separate improvements will be made at 60 facilities each year.
- Complete designs at four locations and provide tramway service to mountaintop ARSR sites where economically justifiable.

Related Projects/Activities: Mechanical and facility modernization work described herein will be completed in consonance with electrical and environmental control system work described in the NAS Plan project titled Power Systems. Communication facilities consolidation, and ACF program final configuration decision, may alter the schedule or requirements.

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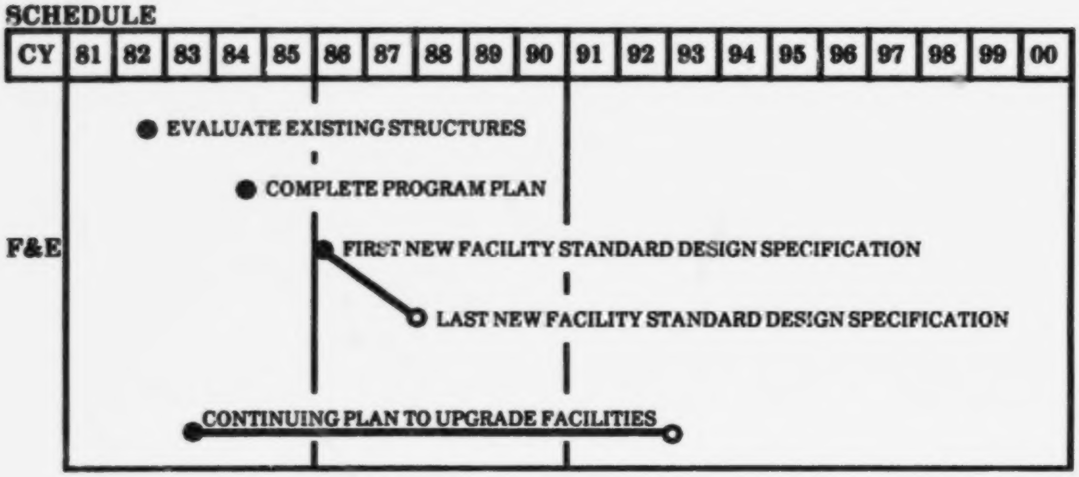
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EVALUATE EXISTING STRUCTURES
COMPLETE PROGRAM PLAN
FIRST NEW FACILITY STANDARD DESIGN SPECIFICATION
LAST NEW FACILITY STANDARD DESIGN SPECIFICATION
CONTINUING PLAN TO UPGRADE FACILITIES

PROJECT 9: ARTCC Plant Modernization

Purpose: This project will assure that adequate facilities are provided for air route traffic control centers. Certain portions of the ARTCC buildings have been operating in their present configuration since the early 1960s. Within the next 6 years, much of the existing plant and structures will require replacement, refurbishment, or upgrading. In addition, new requirements have surfaced due to changing energy, safety, security needs, and new equipment installations.

Approach: Modernization designs will be provided by the Systems Engineering and Integration Contractor. Site adaptation and construction will be by regional contracts. Construction in en route centers specifically required for the implementation of the host computer and the advanced automation system will be funded under the advanced automation program.

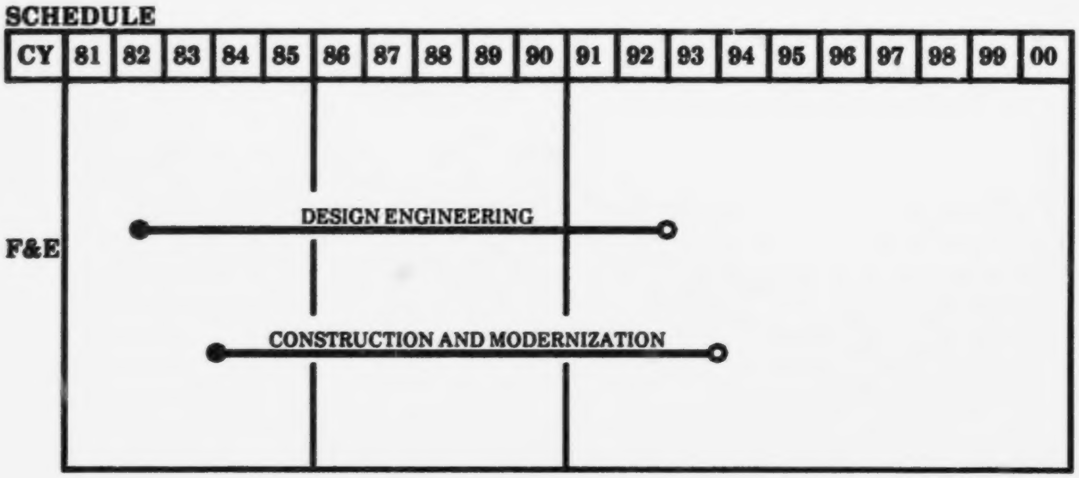
Building rehabilitation and modernization include:

- HVAC system and electrical system replacement or upgrade to include critical and essential system switchgear.
- Refurbishing of interiors, asbestos control, and OSHA compliance.
- Security enhancements.
- Energy conservation.
- Grounds, roads, and parking upgrade.
- Reroofing.
- Central Control Monitoring System replacement and upgrade

Products: En route ARTCC facilities will be involved as follows:

- The 20 existing CONUS centers will house area control facilities and will be upgraded as appropriate to provide an additional 20 to 30 years of service.
- Two offshore centers (Anchorage and Honolulu) will continue in service indefinitely as ACFs and will receive appropriate upgrades.
- The remaining offshore CERAPs (San Juan and Guam) will receive only selected improvements.
- Until the New York TRACON becomes an ACF, it will receive some minor modernization.

Related Projects/Activities: This project will provide the environment and physical plant interfaces with the host computer, the advanced automation system, and ultimately the area control facilities. This mandates an integrated planning and engineering effort to assure the adequacy of the end product and prevent duplication of work. Scheduling and space requirements for the upgraded PCS system provided under the Power Systems project will be integrated into the overall master facility modernization plan. Structural and environmental changes will be coordinated with, and consider requirements for, the earthquake hazard reduction project activity, i.e. conformance to seismic zone requirements and codes.



PROJECT 10: Acquisition of Flight Service Facilities

Purpose: The objective of this project is to acquire the space required to accommodate the modernized FSS configuration of 61 facilities.

Approach: Space for the 61 automated FSSs will be acquired on a sponsor-leased or FAA-provided basis at selected airports throughout the United States and Puerto Rico. The 61 facilities will be designed in accordance with standard FAA operational and technical requirements. These 61 automated facilities will range from 8,000 to 12,000 square feet and be large enough to accommodate all personnel and equipment requirements.

Sixty sites have been selected and approximately 80% are under construction or completed.

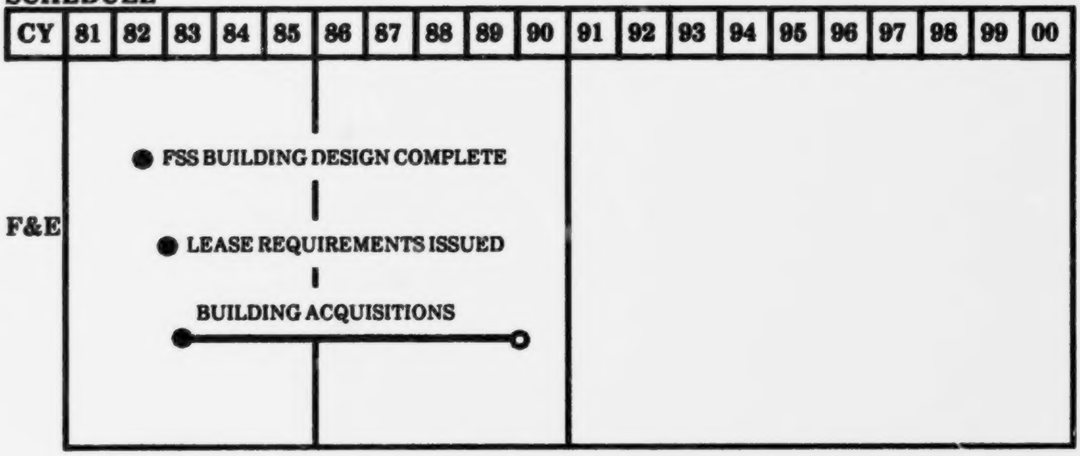
The following factors are considered in evaluating sponsors' proposals for building facilities:

- Life-cycle cost which includes all FAA costs associated with a particular location such as one-time costs, lease costs, maintenance, utility, and service costs. The analysis also considers both lease construction and FAA construction in determining the most cost-effective method.
- Building factors which include location on airport and parking provisions, suitability of technical and administrative space, and electrical distribution and telephone facilities.
- Other factors include telephone exchange capability, number of employees to be relocated, availability of quality housing, number of aircraft operations, and number of based aircraft.

Products: 61 automated flight service stations.

Related Projects/Activities: The integrated communications switching system (ICSS) shall provide the computer-based switching and control equipment required to support FSS air-ground and ground-ground voice communications.

SCHEDULE



PROJECT 11: Aircraft Fleet Conversion/Flight Inspection Modernization

Purpose: This project will reduce costs associated with the flight inspection program necessary for meeting the agency's requirement to maintain a high level of safety for the flying public.

Aviation fuel costs are high. Selective replacement of agency aircraft with fuel-efficient aircraft will provide significant reductions in operational and maintenance costs and fuel consumption.

Replacement of flight inspection aircraft will result in an annual operations savings of $12 million and 2.9 million gallons of fuel. Cost avoidance of 20.2 million for major modifications will be achieved through elimination of requirements to retrofit Sabreliner engines, perform wing modifications, and service life-extension modifications. Replacement of aircraft and related equipment will result in an annual operations savings of $6.2 million and reduce fuel consumption by 2.0 million gallons.

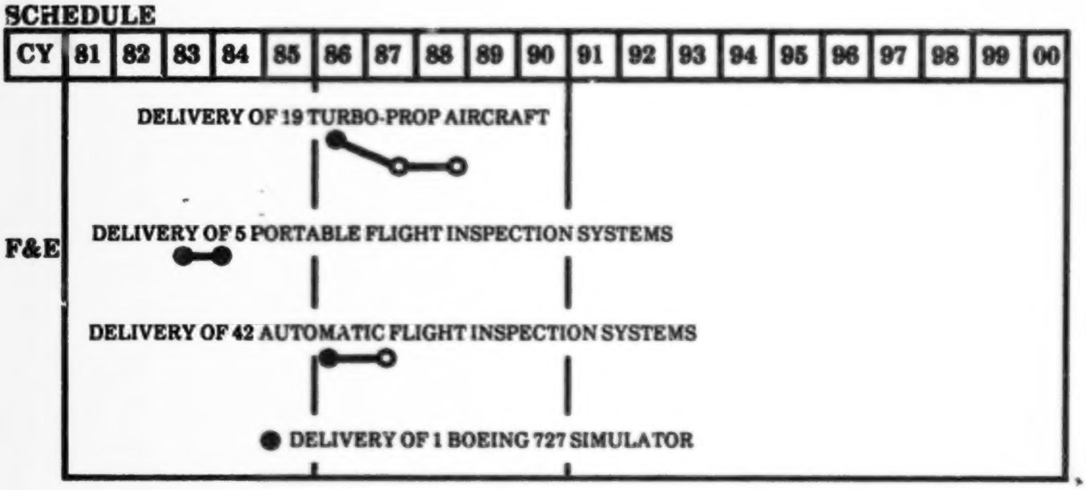
Approach: Replace aircraft presently used to support the agency's five flight programs with fuel-efficient aircraft, employ light-weight flight inspection systems, and upgrade semiautomatic flight inspection systems to increase computer storage capacity and reduce processing time.

This upgrading effort will include addition of RFI investigation capabilities to the flight inspection aircraft fleet.

Products:

- Flight inspection program.
  - 19 turbo-prop aircraft.
  - 5 Portable flight inspection packages.
  - 42 Upgraded automatic flight inspection systems and avionics.
- Flight programs.
  - 1 Boeing 727 simulator.

Related Projects/Activities: The aircraft and automated flight inspection systems receive support from the airborne support complex of the General Support Laboratory, but rely on the Aircraft and Related Equipment project to provide the new system avionics, such as Mode S, GPS, MLS, and LORAN C.



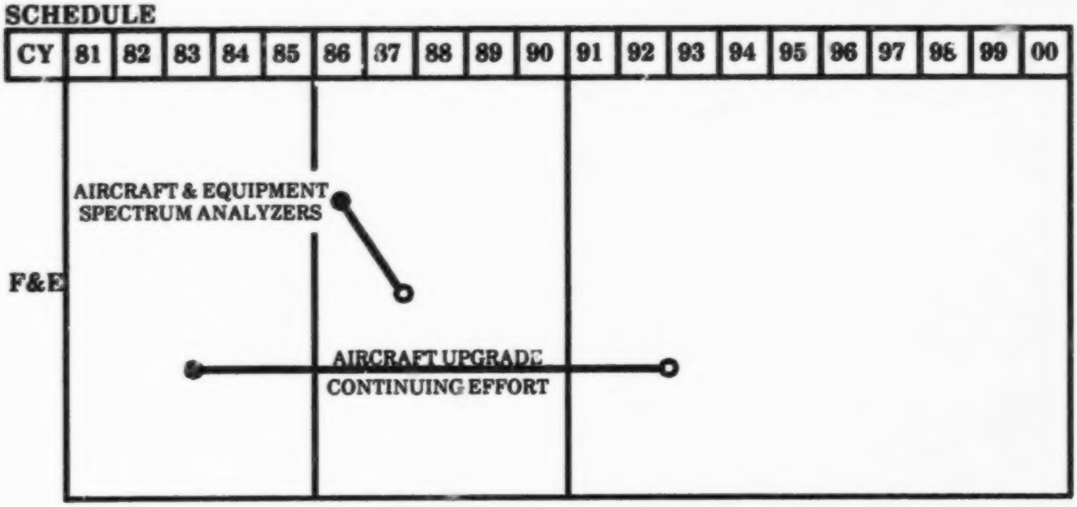
PROJECT 12: Aircraft and Related Equipment

Purpose: This project will provide direct support to the FAA aircraft fleet. It will ensure that the aircraft remain state-of-the-art, current, and safe.

Approach: The aircraft fleet conversion/flight inspection modernization program is well on the way towards implementation. Ongoing efforts will ensure that aircraft used in support of the National Airspace System provide the required capability and functions. The ongoing efforts will meet the requirements for LORAN C, MLS, Mode S, TCAS II, GPS, flight inspection system enhancements, en route automatic flight inspection systems, flight management, improved aerodynamics, and other state-of-the-art enhancements not presently identified.

Products: Mission-ready aircraft upgraded to provide required services on a global as well as domestic basis for MLS, LORAN C, Mode S, TCAS II, GPS, en route automatic flight inspection, and other systems as implemented.

Related Projects/Activities: This project provides the upgraded instrumentation capability for the fleet. The airborne support complex and the general support laboratory are also related as they provide scheduling of modifications, retrofits, and new avionics equipment installation.



PROJECT 13: System Engineering and Integration Contract

Purpose: This project provides management and technical support for the implementation of the NAS Plan. The complexity and high visibility of this Plan requires that unified contractual support be provided to:

- Audit the NAS Plan and provide annual updates.
- Ensure compatibility of existing and evolving systems.
- Identify and compare alternative implementation strategies.
- Assess program impacts.
- Refine technical, cost, and schedule estimates.
- Review technical proposals.
- Evaluate alternative designs.
- Provide technical direction to subsystem contractors.
- Ensure developed items meet specified requirements.
- Integrate subsystems into the operational system.

The requirement for technical expertise in the support of the large systems engineering and implementation effort cannot be met with the available FAA staff.

Approach: A multiyear contract was awarded in 1984 and provides the skills and support tools necessary for implementation of the NAS Plan and integration of all acquired systems.

Products: Engineering documentation and management support for:

- Initial NAS Plan audit and annual updates.
- Program support in the development of functional requirements statements, feasibility and trade studies, performance analysis and model, system designs, system integration plans, system implementation strategies, logistics, and training plans.
- Project management support for requirements analysis, specification development, procurement package review, proposal evaluation, contract monitoring and technical evaluation, and direction of field installation.
- Control tools and systems for benefits analysis, cost analysis, schedule analysis, risk analysis, configuration management, and program control and monitoring.

Related Projects/Activities: The system engineering and integration contract provides systems engineering support to the FAA on all NAS Plan projects.

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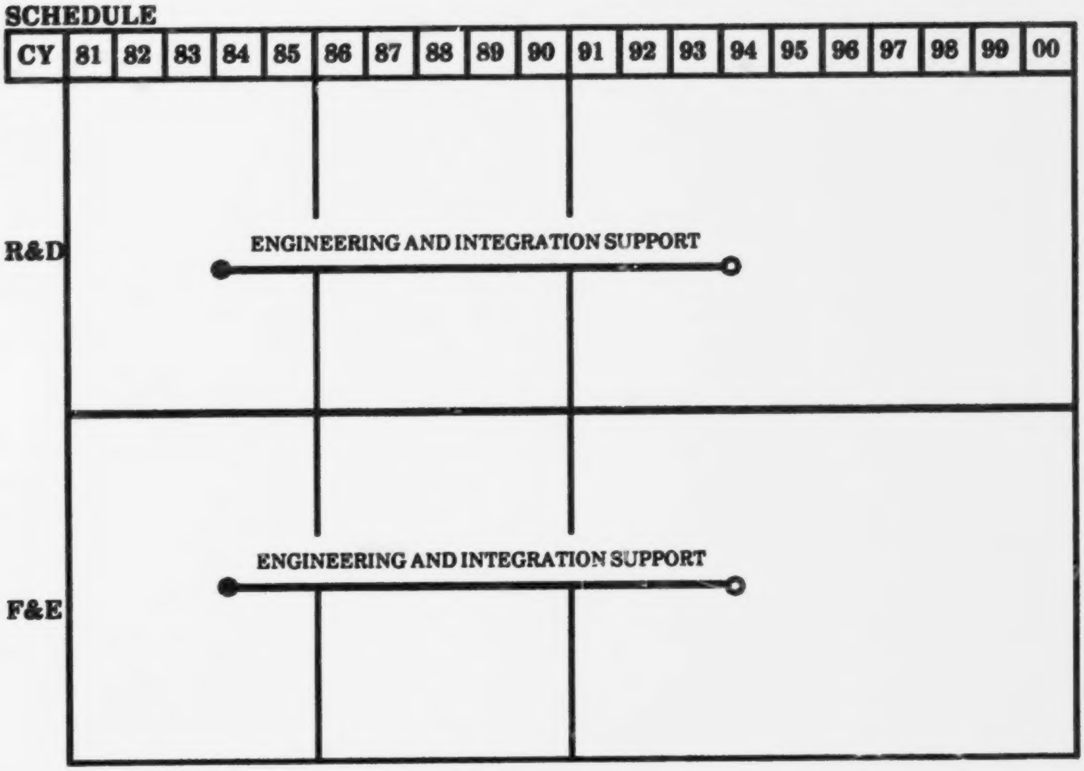
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PROJECT 14: National Radio Communications System (NARACS)

Purpose: In the event of a national or local emergency which may temporarily disrupt landline communications between NAS facilities, the FAA must have the capability to establish minimum essential command and control communications entirely by radio without any dependence upon landlines. The establishment of a national radio communications system (NARACS) will provide communications coverage with FAA headquarters, regions, field facilities, aircraft, and other Federal, state and local government agencies. In addition, the network will also be available for routine purposes on a daily basis for use in dispatching and redirecting Airway Facilities maintenance technicians, aviation security, accident investigations, and other NAS activities. The NARACS is based on National Security Decision Directives (NSDD-47,-97 145).

Approach: Phase I established a high-frequency/single-sideband (HF/SSB) backbone system, or control network with nodes, at FAA headquarters and at three emergency operating facilities. Seattle and Anchorage HF/SSB radio systems will be upgraded to enable them to operate as an extension of the backbone network. The backbone network will also have voice and data privacy.

Phase IA is being implemented and will upgrade and enhance the communications security terminal equipment operated with the automated digital network (AUTODIN).

Phase II will establish two geographical networks with HF/SSB radio communications equipment to interface with the national command/control backbone communications network. The two networks, called Eastern and Western Nets, will provide radio communications with the regional offices, ARTCCs, FIFOs, major airports, FAA support aircraft, and other key facilities within each area. These networks will have the capability to transmit voice and data messages in the clear or private mode. The HF portion of NARACS shall be protected from Nuclear, High-Altitude Electromagnetic Pulse (HEMP).

Phase III is being implemented and will provide highly reliable two-way radio communications, which are independent of common telecommunications carrier, in any location in the region as well as in the United States with proper automatic/manual interfacing and linking with other networks of NARACS. Each regional network will become an integral part of NARACS. Network design will enhance and support the 80s maintenance concept where technicians will be dispatched to facilities from central maintenance work centers via mobile/portable radios, repeaters, and fixed base radios. The networks will also be utilized for scheduling assignments, issuing reports, and for emergencies. The regional networks will be capable of transmitting messages in the unsecure voice mode or data encryption standard (DES) mode. Radio links will be installed as necessary to provide radio connectivity between regional FM and national HF networks. RCL equipment will be used to the maximum extent possible to satisfy connectivity requirements.

Phase IV will expand and enhance the HF/SSB backbone network for full-duplex, voice, and data transmission. This effort will include the establishment of remote sites at Atlanta and Denver and provide HF radio transceivers at automated flight service stations and radio links for the remote sites, including the facilities in the Washington headquarters area. In addition, Phase IV will provide a HF/SSB transportable communications capability.

Phase IVA is being implemented and will establish the federal secure telephone network (FSTN) at Washington headquarters, regional offices, ARTCCs, and other major field offices.

Products:

- Phase I – Communications control center, FAA headquarters, and three national emergency operations facilities (NEOF).
- Phase IA – COMSEC network upgraded to AUTODIN.
- Phase II – Eastern and western networks.
- Phase III – Regional networks.
- Phase IV – Duplex system for backbone network.
- Phase IVA – Federal secure telephone network.

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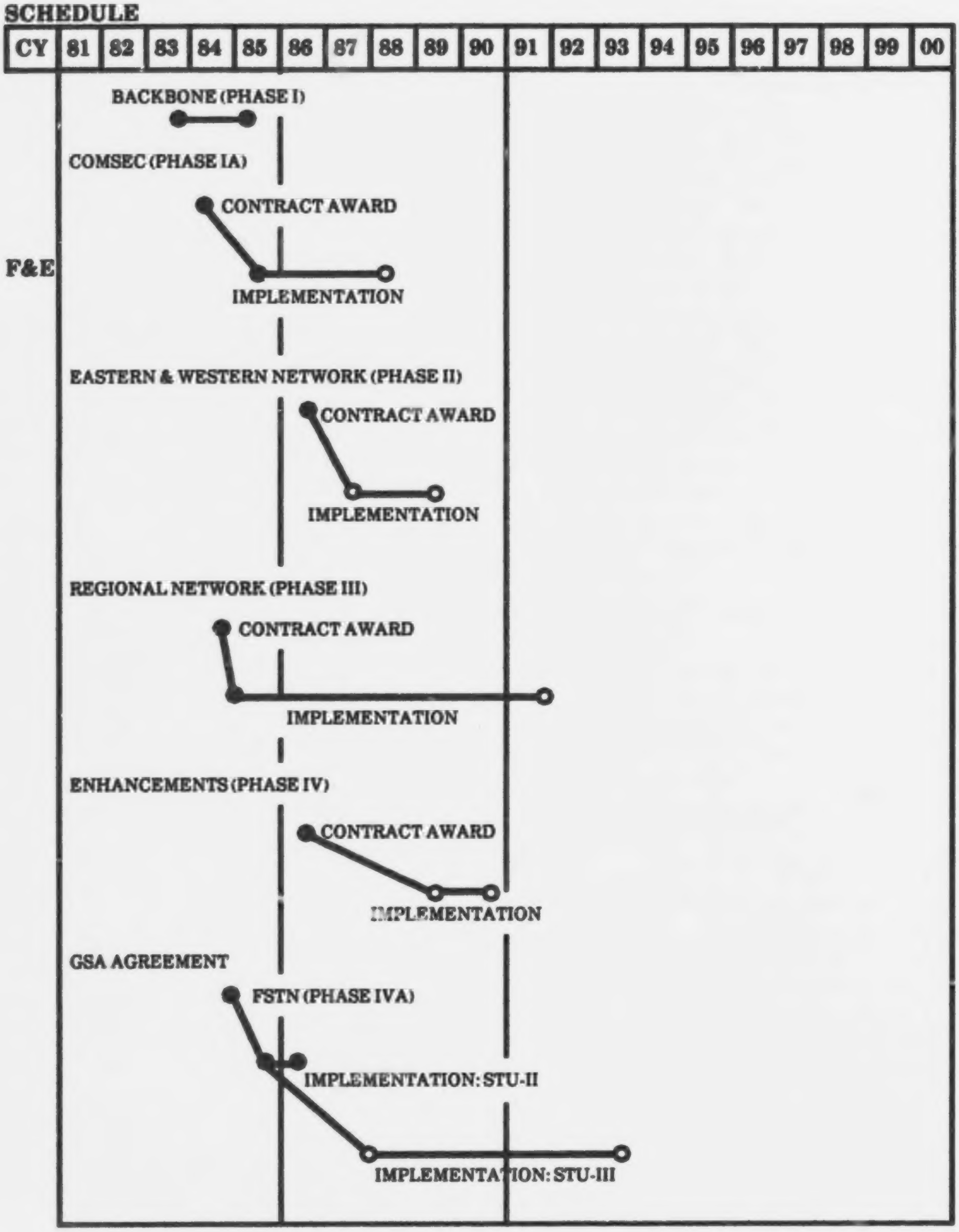
Related Projects/Activities: NAS spectrum engineering is essential to ensure proper channel spacing and availability. Noise and external interference will be minimized by proper spectrum engineering. Interface requirements of NARACS equipment with the maintenance control center need to be satisfied and closely coordinated to assure good hardware and software integration. NARACS will use the RCL for interregional and intraregional connectivity. Other methods, such as microwave, UHF/VHF and low power HF, will be used where RCL is not available.



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PROJECT 15: NAS Spectrum Engineering

Purpose: This project will provide spectrum utilization support necessary for the interference-free operation of the modernized NAS. The NAS is dependent upon the use of radio frequency spectrum. Therefore, effective management of the radio spectrum, including electromagnetic compatibility aspects, is vital to the implementation of the NAS Plan.

Approach: Develop frequency plans to ensure that adequate spectrum is available for each NAS Plan project requiring frequencies.

This planning effort involves electromagnetic compatibility analysis, large scale frequency assessment studies, formal spectrum certification required by National Telecommunications Information Administration (NTIA) for new systems, national and international frequency coordinations, radio propagation studies, and facility networking.

Represent the U.S. in meetings of the ITU and ICAO to protect U.S. aviation interests. These meetings develop policy, technical procedures, and criteria concerning the use, sharing, management, or allocation of the radio spectrum for the NAS as well as other aviation systems.

Obtain and protect necessary frequencies for the NAS facilities through automated computer techniques to the extent possible. Investigate and resolve radio frequency interference (RFI) problems. High-power AM, FM, and TV stations are serious interference sources to both ground and avionic equipment. Resolution and prevention of this type of interference involves close coordination with the broadcasting industry, FCC, and ICAO.

Investigate and conduct field measurements of potential personnel radiation hazards to ensure all existing and planned NAS facilities meet existing U.S. standards.

Provide facility coverage charts necessary for proper engineering of frequencies and for networking of communications, navigation, surveillance, and DF systems.

Provide U.S. telecommunications support to international civil aviation as required in the NAS Plan. This involves extensive international coordination on aeronautical mobile and fixed services (HF, AFTN, WAFS, etc.).

Products:

- Frequency plans in support of the NAS Plan include MLS, high-altitude EFAS, 25 kHz air-ground communications, RCL, NARACS, and, NEXRAD.
- EMC guidelines for facility consolidation.
- Frequency authorization and formal spectrum approval from the National Telecommunications and Information Administration.
- Facility coverage charts.
- Spectrum engineering studies in support of the NAS plan. These studies include frequency engineering models, RFI suppression devices, investigation of state-of-the-art technology and procedures for RFI elimination, AM/FM/TV interference evaluation, etc.

Related Projects/Activities:

- Spectrum engineering lab at the FAA Technical Center, a subset of the General Support Lab, provides the test bed and electromagnetic compatibility analysis necessary to accomplish the spectrum management function.
- Spectrum engineering supports, as a minimum, the following NAS Plan projects:

  MLS, ILS, VORTAC, RMM, LLWAS, AWOS, HIWAS, Airport Telecommunications, EFAS, Mode S, ARSR-4, NEXRAD, TDWR, RCL, NARACS, ATIS, ASDE-3, ASR-9, RCF, A/G Comm. Mod. NDB, Communications Facilities Consolidation/Network, DF, Power Systems (EMC Issues, etc.), Aircraft Fleet Conversion/ Flight Inspection Modernization, Long-range Radar Replacement, Terminal Radar Replacement and Establishment, ATCBI Replacement and Establishment, NADIN, ACF, ATCT/ TRACON (Establishment, Replacement, and Modernization), Visual AVAIDS.

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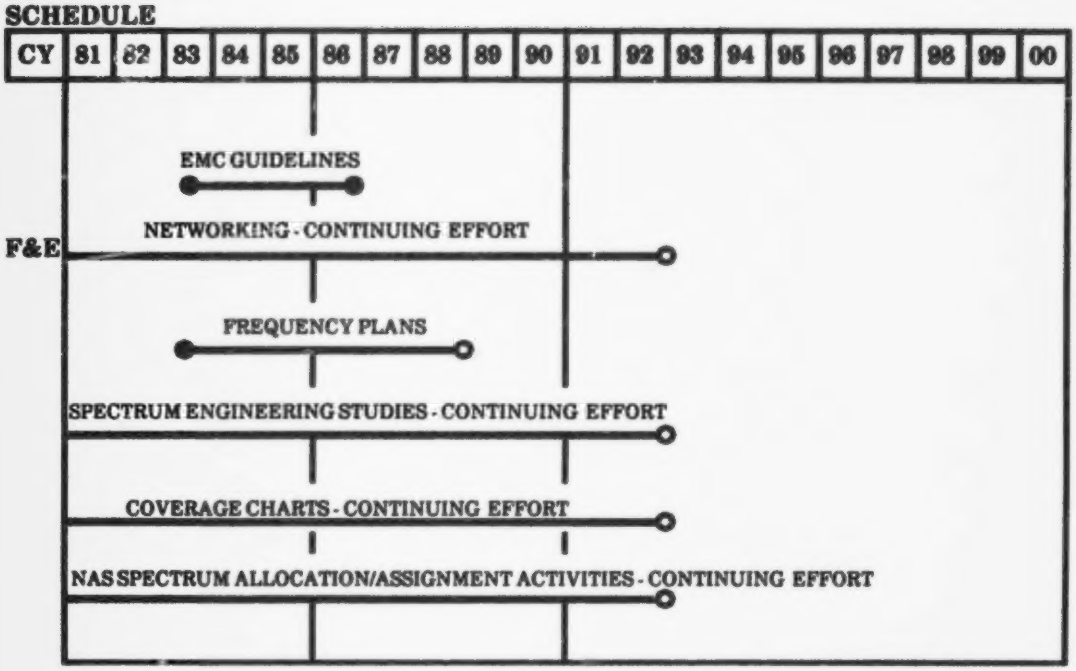
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FREQUENCY PLANS
SPECTRUM ENGINEERING STUDIES - CONTINUING EFFORT
COVERAGE CHARTS - CONTINUING EFFORT
NAS SPECTRUM ALLOCATION/ASSIGNMENT ACTIVITIES - CONTINUING EFFORT

PROJECT 16: General Support

Purpose: This project covers efforts in direct support of the overall National Airspace System and the ongoing F&E investments that are not covered elsewhere in the plan. They generally improve operations, provide added capabilities, and promote safety.

Approach: Nonrecurring low-cost F&E projects which have been included in recent budget requests are: information processors for the aviation safety analysis system; universal printed circuit board testers for installation at planned consolidated maintenance facilities; explosive detection systems; mechanized warehouse storage/ retrieval system; automated logistics and inventory system (LIS), including on-line field requisitioning at the Aeronautical Center Depot, providing radomes at beacon-only sites; procuring calibration standards to certify test equipment; a computer-aided engineering design system at each regional office; three level weather for ARTCC displays.

Certain ongoing efforts must continue to support the National Airspace System. These include: in-house and contractual engineering, design, and analysis for quick reaction engineering and other technical assistance; minor regional and locally identified modifications, refurbishments, and equipment relocations; improvement and leasing of Technical Center plant and facilities; earthquake hazard reduction of facilities; procurement, rehabilitation or replacement of equipment for use in the engineering and development programs at the FAA Technical Center; where cost beneficial, purchasing land or acquiring protective easements for existing facilities rather than continuing to lease properties; real estate and contract management; upgrading of existing support equipment; en route hardware and software systems development and support; ATCRBs support; ARTS II MSAW topography and graphics; replacement of radomes at long range radar sites; and projects to meet Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) standards at FAA facilities.

Products:

- Nonrecurring projects.

  -Information processors to support the aviation safety analysis system.
  -Printed circuit board testers.
  -Explosive detection systems.
  -Mechanized warehouse storage/retrieval system.
  -Automated logistics and inventory system (LIS), including on-line field requisitioning.
  -Upgrade the FAA Technical Center plant support complex.
  -Computer-aided engineering design systems.
  -Test equipment calibration standards.
  -Install false reply blanking units at 30 terminal beacon sites.
  -Provide radomes at beacon only sites.
  -Three level weather for ARTCC displays.

- Ongoing projects.

  -Engineering, designs, and analyses.
  -Regional and local minor projects.
  -Improvements of the plant and facilities at the FAA Technical Center.
  -FAA Technical Center building lease.
  -Purchase and leasing of land and easements.
  -Regional Logistics Contract Support.
  -OSHA and EPA improvements.
  -Printed circuit board maintenance software.
  -Replace radomes at FPS-20/60 and ARSR 1/2 sites not scheduled to be replaced by ARSR 4.
  -Airports precise reference data program.
  -Leasing of space.
  -Earthquake hazards reduction.
  -ARTS II MSAW topography and graphics.
  -ARTS III Support.
  -En Route hardware and software systems support.
  -ATCRBS support.

Related Projects/Activities: This program supports ongoing F&E efforts and operations.

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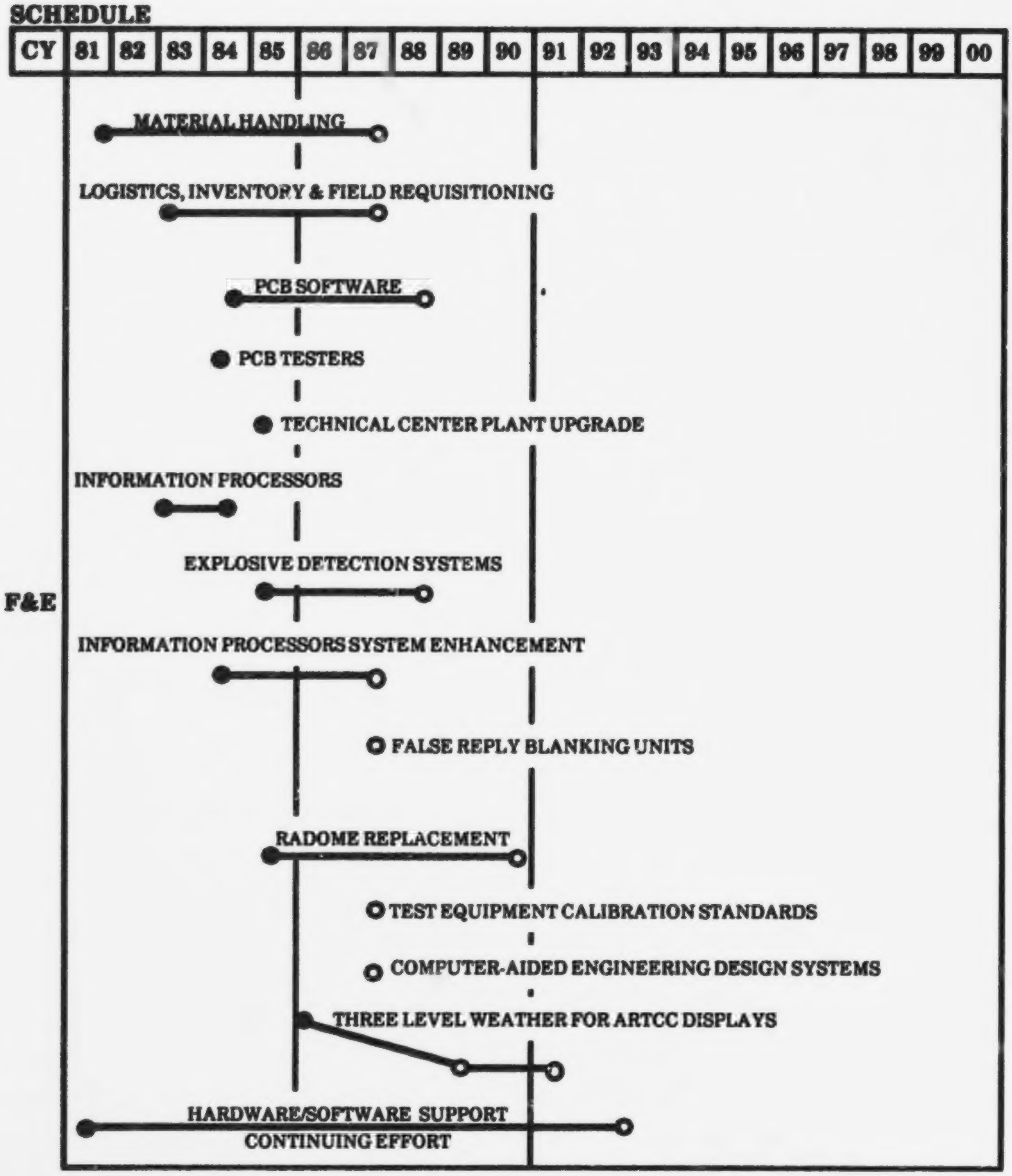
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PCB TESTERS
TECHNICAL CENTER PLANT UPGRADE
INFORMATION PROCESSORS
EXPLOSIVE DETECTION SYSTEMS
INFORMATION PROCESSORS SYSTEM ENHANCEMENT
FALSE REPLY BLANKING UNITS
RADOME REPLACEMENT
TEST EQUIPMENT CALIBRATION STANDARDS
COMPUTER-AIDED ENGINEERING DESIGN SYSTEMS
THREE LEVEL WEATHER FOR ARTCC DISPLAYS
HARDWARE/SOFTWARE SUPPORT
CONTINUING EFFORT

PROJECT 17: System Support Laboratory

Purpose: This project will provide technical support for the current field systems and for test, evaluation, and integration of new systems. In support of FAA policy on test and evaluation, this laboratory at the FAA Technical Center will duplicate future system equipments and interfaces necessary to establish realistic environments for operational tests and evaluations and for human factors testing. The testing will assure that total system requirements, including human interface requirements, are met prior to installation at field facilities. Upon completion of operational tests and evaluations, systems are integrated into the laboratory for direct field support; for development and testing of hardware, software, and firmware modifications to the system; and for support of new system developments.

Equipment in this laboratory establishes the configuration baseline for field operational systems. Modifications are installed, tested, and baselined on these systems prior to installation at field facilities. These systems provide for centralized maintenance and field support system configurations, and interfaces are determined by the fielded systems. System-to-system interfaces are also baselined and configuration controlled.

Approach: The System Support Laboratory is partitioned into six support complexes:

- En route systems.
- Terminal systems.
- Flight service and weather systems.
- Ground-to-air systems.
- Interfacility communications systems.
- Maintenance and operations support systems.

A transition plan is being developed by the FAA Technical Center consistent with the Master Transition Plan and the Master Baseline Schedule. The FAA Technical Center transition plan will identify space requirements, installation plans, and evolutionary changes required to ensure the integrity of the configurations in the System Support Laboratory. The plan will also identify system interdependencies and switching capabilities of system configurations required for system development, integration testing, and field support activities.

Products: System Support Laboratory.

Related Projects/Activities: A majority of major F&E programs.

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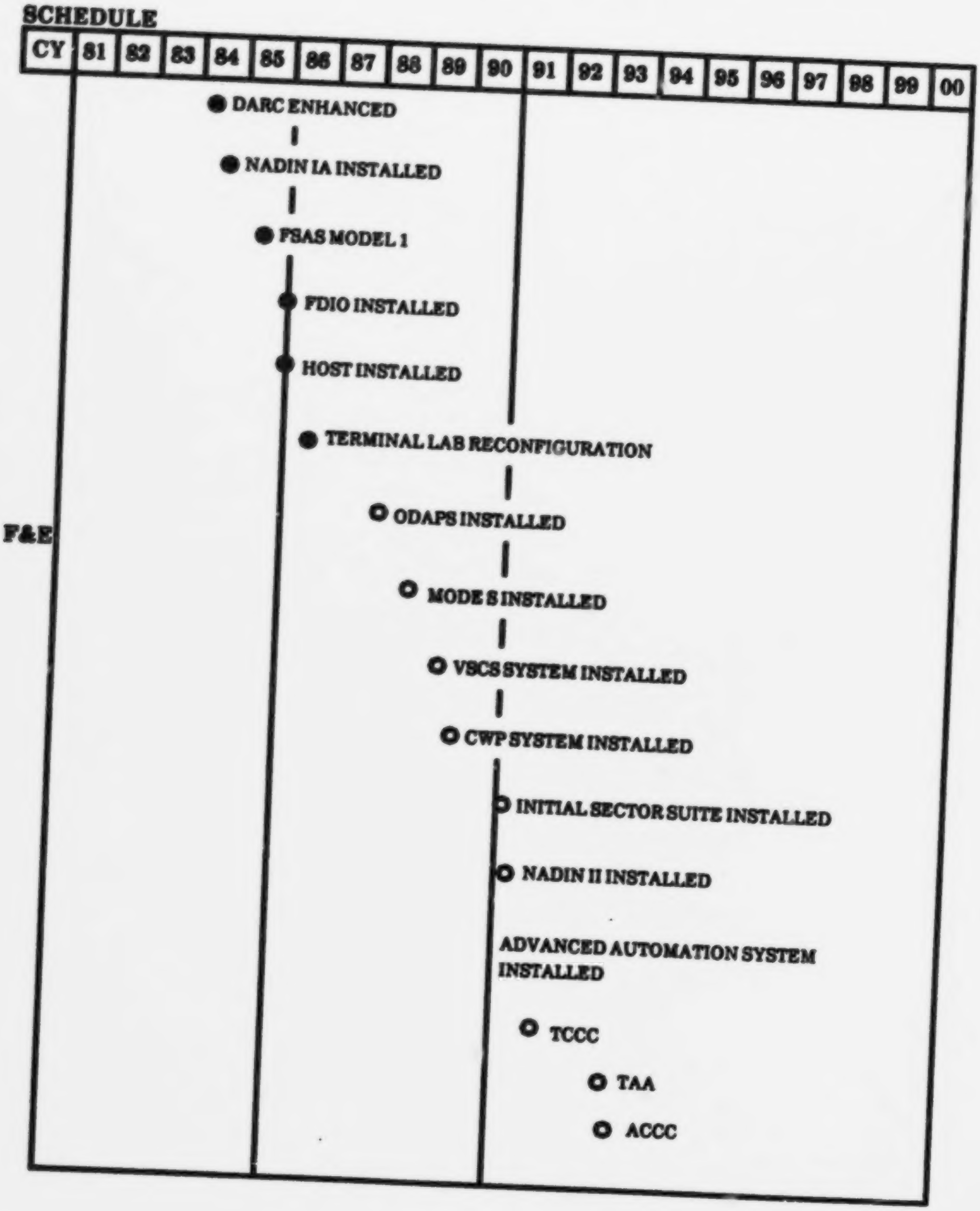
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● FSAS MODEL 1
● FDIO INSTALLED
● HOST INSTALLED
● TERMINAL LAB RECONFIGURATION
○ ODAPS INSTALLED
○ MODE S INSTALLED
○ VSCS SYSTEM INSTALLED
○ CWP SYSTEM INSTALLED
○ INITIAL SECTOR SUITE INSTALLED
○ NADIN II INSTALLED
ADVANCED AUTOMATION SYSTEM INSTALLED
○ TCCC
○ TAA
○ ACCC

PROJECT 18: General Support Laboratory

Purpose: This project will provide general systems, equipment, and aircraft for support of the System Support Laboratory, other laboratories supporting R&D projects, and operational requirements.

Approach: The General Support Laboratory is partitioned into distinctive complexes which include:

- Airborne support.
- Electromagnetic support.
- Simulation support.
- Test integration and control support.
- General purpose data processing support.

Resources provided by these complexes are shared by systems and projects within the FAA Technical Center laboratories for system support (Project 17), research and development, and regulatory support. Both the Research and Development and Regulatory Support Laboratories are concerned with design, research, development, test, and evaluation of advanced concepts, procedures, and systems being considered for introduction into the NAS. The NAS Simulation Support Facility provides pilot-to-controller voice communications, pilot initiated aircraft maneuvers, and computer generated aircraft radar returns for large samples of traffic. These functions support system tests requiring real-time simulation of present or future airspace environments, and can be input to various air traffic control systems in the Technical Center's laboratories. The General Purpose Data Center supports computational models as well as reduction and analysis of data obtained in tests or research.

Individual plans are being developed to upgrade the General Support Laboratories and systems to satisfy future requirements. The plans will be responsive to the NAS F&E Plan requirements, R,E&D Plan requirements, and various technical program requirements. The plans will include identification of inter-laboratory support capabilities, for example, general purpose data center providing data processing and reduction services to the System Support, Research and Development, and Electromagnetic Support Laboratories. The aircraft fleet also supports these laboratories.

Products: An upgraded General Support Laboratory.

Related Projects/Activities: Many of the major F&E programs.

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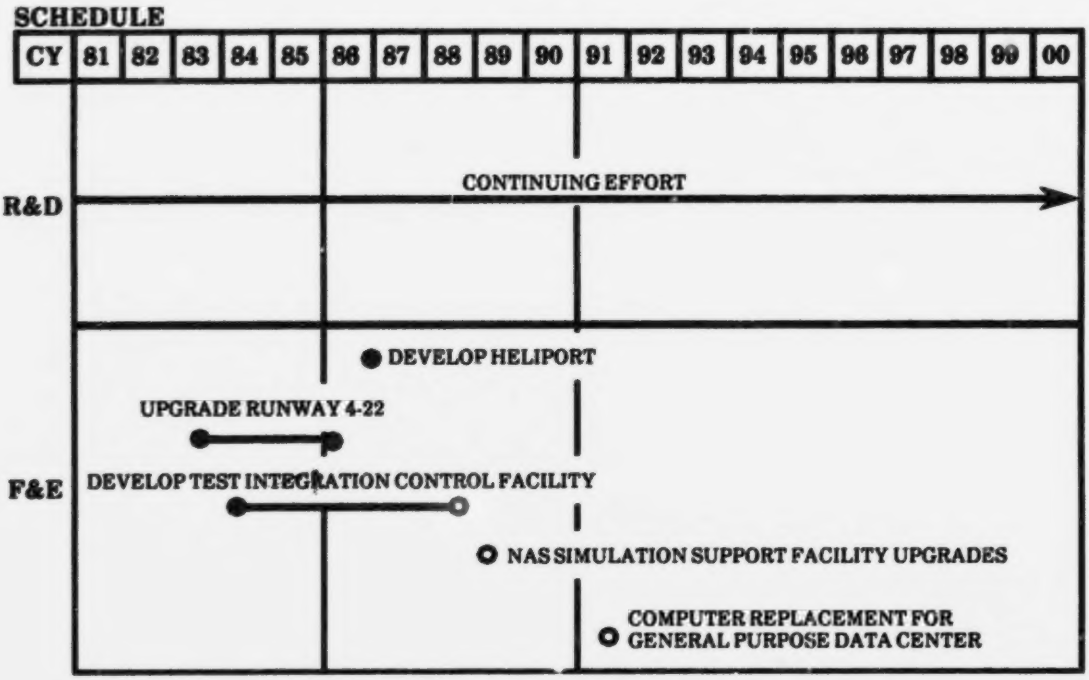


CHAPTER VII

OTHER CAPITAL NEEDS

OTHER CAPITAL NEEDS

INTRODUCTION

As the implementation of the NAS Plan for Facilities and Equipment progresses, other capital needs have and will become apparent. Prior revisions of the NAS Plan have accommodated new initiatives; such as the use of LORAN C for non-precision approaches and expanded mid-continent navigational coverage, and replacement of the air traffic control computers used at the New York TRACON. Near term, additional opportunities exist to functionally improve the air traffic control system, avoid costs associated with NAS operation and maintenance, and satisfy a variety of NAS administrative needs.

Long term, there will be sustained aviation growth, the need for improved services at an affordable cost, and the need to accommodate a greater variety of vehicles, e.g., supersonic and hypersonic vehicles foreseen by the White House Office of Science and Technology Policy. These needs will cause the NAS to continue to evolve. Evolution of the NAS will occur through integration of developments obtained from research and the exploitation of new technology, enhancements of NAS Plan provided capabilities, and extension of near-term modernization initiatives.

RESEARCH AND TECHNOLOGY INITIATIVES

FAA and other aeronautical research and technology initiatives are underway today. FAA Research, Engineering and Development (R, E & D) is focused on improving safety and security, increasing airspace and airport capacity, reducing airborne and ground delays, improving services derived from NAS Plan acquired equipments and facilities, and extending ATC services to classes of aviation users who operate or wish to operate in more airspace--oceanic, low-altitude, offshore, remote areas, and high altitude. The FAA Plan for R, E & D describes activities related to the potential use of new technology, such as satellites for air-ground communication, navigation and surveillance.

THE NAS PLAN

The improvements implemented by the NAS Plan will enhance the reliability and availability of NAS facilities and services. The plan provides additional equipment for new qualifying locations in response to growth in aviation activity. The plan also provides for facility consolidation and equipment modernization to reduce FAA operations and maintenance manpower requirements, as well as for controller automation aids to further enhance agency productivity. Equally important, the NAS Plan provides for a number of enhancements that will improve capacity, user productivity, and safety.

Through the AAS, the ATC process will become far more flexible, and more automatic than it is today. In addition, information available on weather and winds will be improved and information flow will be enhanced through the use of digital data link communications. There will be a great deal more strategic planning in traffic flow management than exists today, and the system will be more capable of rapid, dynamic adaptation as situations change.

En route and terminal ATC functions will be consolidated, and new functions will be added in the AAS, to be installed in Area Control Facilities. For example, new en route functions will facilitate user-preferred trajectories, and will improve safety by probing for aircraft and airspace conflicts along such trajectories. If conflicts are detected, these functions will alert controllers and provide effective resolutions that will minimize delays. At the en route-terminal interface, metering functions will organize selected en route traffic and schedule departure traffic over departure fixes into the en route traffic flows. Metering functions also will organize arriving traffic in accordance with terminal acceptance rates; if airborne delays are inevitable, they will be able to be taken in high-altitude airspace for improved fuel efficiency.

Further, Mode S will provide an air-ground digital data link capability. Initial data link service will provide weather products from existing weather data bases on request to aircraft in flight. These weather data will enhance flight safety and user productivity by providing current information for flight operation.

The MLS will provide more flexible approach paths than does the existing Instrument Landing System (ILS); it will support selectable glide slope angles, and curved and segmented approaches to runways. These features will permit instrument approaches to separate short runways by VTOL, STOL, and general aviation aircraft, and will reduce landing minima at runways where ILS performance is the limiting factor.

The Flight Service Automation System (FSAS) will enhance flight safety and user productivity by improving the quality of data bases containing flight planning information on weather, facilities status, and system delays. In addition, automated user access to these data bases will be provided via voice response systems and users' computer terminals.

The NAS Plan also includes a number of significant improvements to surveillance and weather data collection, analysis, and distribution. These improvements will result in enhanced flight operations and air traffic control. Two principal benefits will accrue--safer flight operations and improved user productivity through more reliable flight planning.

INTEGRATING NAS PLAN AND NEW TECHNOLOGY

Aviation growth and demand for better service requires the continued long term capital improvement of the NAS beyond that provided by the NAS Plan. The challenging decisions for future improvement will revolve around the determination of the best programmatic approach to improve safety and security, extend services, increase capacity and reduce delays within acceptable levels of cost.

The NAS Plan provides a foundation for further improvements to meet additional future requirements. Further improvements will be achieved by a balanced program which: introduces new technologies and systems, in particular satellites; exploits future technology opportunities; enhances NAS Plan provided hardware and software; or deploys additional amounts of established NAS Plan type technology.

While the technology or technique choices may be clear, for example, ground based versus satellite surveillance, it will be difficult to decide on the appropriate mix of technology, formulate an appropriate transition strategy, and resolve the procedural interoperability and user implication of introducing advanced technology. Much may be gained through long-term change but much is at risk. The promise of introducing advanced technology will be carefully weighed against its associated risks and the necessity of ensuring the continuous existence of a safe, operational NAS. Safe operation of the NAS will be the major consideration in future evolution of the system. No change to the NAS will be permitted which reduces safety.

SUMMARY OF OTHER CAPITAL NEEDS

The evolution of the NAS Plan to provide safe and efficient use of the nation's airspace has now progressed for five full years. During this period, integration of projects into the NAS has highlighted additional opportunities for improved management and administration, cost avoidance and NAS functional improvements. The continuing review process has also forced consideration of anticipated future demands and has fostered extensions of the original 1982-1992 NAS Plan. Introduction of new technologies and enhancements will continue the process of cost-beneficial modernization and replacement of aging systems in the years beyond 1992.

This chapter, describing other capital needs of the National Airspace System, has been catalogued both chronologically and functionally. The nearer term (pre-1992) projects will be implemented as a complement to the original NAS Plan. The longer term (post-1992) projects are intended for implementation of advanced technology, using the original NAS Plan as the foundation for enhancements and exploiting future technology opportunities.

ADMINISTRATIVE NEEDS (PRE-1992)

NAS software en route automation support, which has in the past been provided in-house, will be accomplished by contractor personnel, thus permitting the air traffic control personnel to return to more critical and direct performance duties.

Contractually procured ADP services will provide a standard, agency-wide administrative resource to fulfill the total facilities management requirements of the headquarters, regions and centers in a cost effective manner.

The Mike Monroney Aeronautical Center is leased from the Oklahoma City Airport Trust. This project will fund the lease of the facility and land.

ATC SYSTEM FUNCTIONAL REQUIREMENTS (PRE-1992)

The expansion of the en route flight advisory service (EFAS) will provide additional communications channels for coverage to 18,000 ft. and above, for dissemination of en route weather and pilot report information.

Radio frequency interference is becoming more severe as the rf spectrum becomes more crowded and facilities are consolidated. This project will provide updated equipment to solve these problems and meet rf spectrum requirements.

COST AVOIDANCE OPPORTUNITIES (PRE-1992)

The FAA and the DOD will jointly fund a project to replace existing high-power requirement, mechanically rotated TACAN antennas with solid state equipment. This will reduce power requirements, permit removal of engine generators and associated fuel storage tanks and provide more reliable and available TACAN systems.

Computer based instruction (CBI) has proven to be a particularly cost effective and efficient method to meet FAA training requirements. Expansion and upgrade of the current CBI will provide an agency-wide system to provide training for personnel at all Air Traffic and Airways Facilities field locations.

Reliable interfacility communications will continue to be the foundation of a safe national airspace system. The commitment to continue to reduce dependence upon high-cost leased communications systems will continue to be pursued through additional procurements to improve service and reduce costs.

The Federal government has agreed to participate with local, state and county authorities to identify, inspect for leakage, cleanup as required and monitor all underground fuel storage tanks. The FAA will vigorously support this effort to reduce the potential and present environmental pollution.

NAS PLAN EXTENSION (POST-1992)

If there continues to be a requirement for primary radar for terminal surveillance, the system must be upgraded in the period beyond 1992. Either digitizing or replacement of the ASR 7 and ASR 8 will be required to support the ACF.

Continuing support is required to sustain the NAS equipment and facilities due to changes in operational requirements and environments or changes in airport or air traffic demands. This project will provide that support to national programs and regionally sponsored and managed projects to maintain NAS facilities and equipment.

ATC FUNCTIONAL IMPROVEMENTS (POST-1992)

Weather communications processor capacity will be expanded to support the higher transaction rates and support a greater number of Mode S data link equipped users. Additional data link services will be accommodated including weather radar graphics, filing of pilot reports, NOTAM data and delivery of aviation route forecasts.

Airport surface detection equipment (ASDE) provides reliable aircraft and airport service vehicle surveillance. ASDE has positive safety implications during periods of low visibility and high surface traffic conditions. More airports will qualify for these systems in the future.

COST AVOIDANCE OPPORTUNITIES (POST-1992)

New generation runway visual range equipment will be used to replace the older, less reliable existing equipment now serving the nation's airports.

The air traffic control radar beacon system currently in use employs several interrogator types. The existing Mode S program will replace a number of the older units; however, a large number of ATCRBS interrogators will remain in the system. Replacement of these units with additional Mode S units or monopulse systems is the preferred option for ground-based surveillance.

Based on continued use of primary radar to provide en route surveillance, it will become necessary in the FY 96 time frame to replace the older long-range tube-type radars currently in the surveillance network.

PROJECTS PRE - 1992	IMPLEMENTATION	
	FIRST	LAST
ADMINISTRATIVE NEEDS (PRE-1992)		
1. Data System Specialist Support	1986	1987
2. Administrative Data Processing (ADP) Facilities Management	1988	1997
3. Aeronautical Center Lease	1987	1987
ATC SYSTEM FUNCTIONAL IMPROVEMENTS (PRE-1992)		
20. EFAS Expansion	1991	1993
30. Air/Ground Communication Radio Frequency Interference (RFI) Elimination	1990	1995
COST AVOIDANCE OPPORTUNITIES (PRE-1992)		
40. Low Power TACAN Antennas	1990	1995
50. Sustain Telecommunications Support	1990	1997
60. Computer Based Instruction (CBI) Expansion	1989	1992
61. Fuel Storage Tanks	1988	1995

PROJECT SUMMARY

PROJECTS POST - 1992	IMPLEMENTATION	
	FIRST	LAST
NAS PLAN EXTENSIONS (POST-1992)		
70. Terminal Radar Digitizing, Replacement and Establishment	1996	2001
71. Sustained National Airspace System Support	1992	1997
ATC SYSTEM FUNCTIONAL IMPROVEMENTS (POST-1992)		
80. Weather Communications Processor (WCP)/Data Link Enhancements	1996	1998
81. Additional ASDE Establishment	1997	1998
COST AVOIDANCE OPPORTUNITIES (POST-1992)		
90. Runway Visual Range (RVR) Replacement and Establishment	1995	1998
91. ATCBI Replacement and Establishment	1998	2002
92. Long Range Radar Replacement and Networking	1996	2001

PROJECT SUMMARY CONTINUED

PROJECT 1: Data System Specialist Support

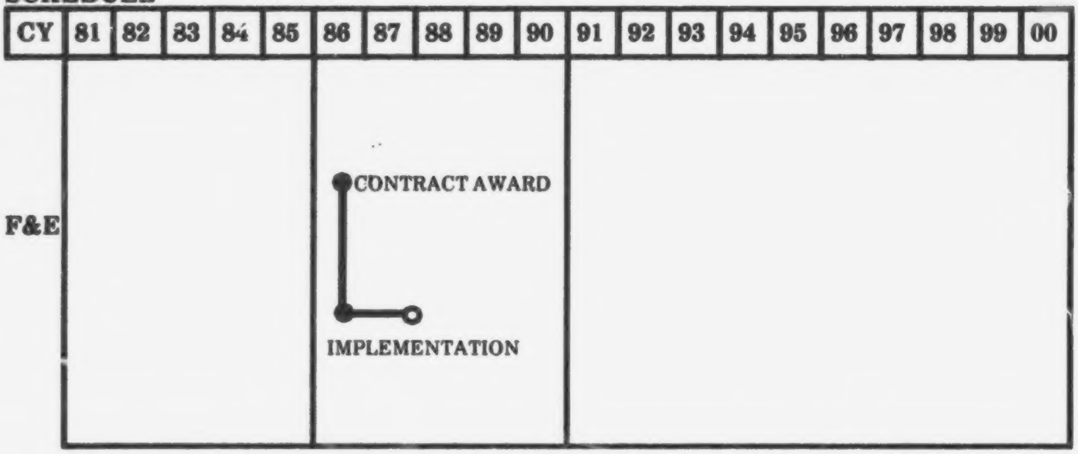
Purpose: This project provides NAS software automation support at en route air traffic control facilities. In the past, the data system staff functions were performed by in-house air traffic control specialists.

Approach: The ARTCC Host computer contract was modified in mid 1986 to meet the overall en route automation program support requirement at 20 ARTCCs. This F&E support will continue through 1987, at which time operations funding will be used to sustain the effort.

Products: Data systems support to perform software maintenance on real-time air traffic control computer systems at 20 ARTCCs.

Related Projects/Activities: None

SCHEDULE



PROJECT 2: Administrative Data Processing (ADP) Facilities Management

Purpose: This project supports the ADP needs of the agency by creating a uniform, agency-wide administrative computing resource. Through such a resource, the inconsistencies and capacity shortfalls of the current ADP system will be alleviated, and will be actively avoided in the future. To accomplish this, the project will secure ADP services which will provide for total facilities management and turnkey operations. The objectives of this effort are:

- Provide timely, responsive and economical general purpose ADP resources.
- Balance agency workloads and priorities.
- Shorten procurement cycles, reducing related expenditures.
- Provide backup processing capabilities.
- Refresh technology as needed in the future.
- Facilitate systems integration and ADP standardization
- Establish uniform chargeback mechanisms.
- Satisfy, in a timely manner, the information needs of the agency with regard to its mission and administrative requirements.

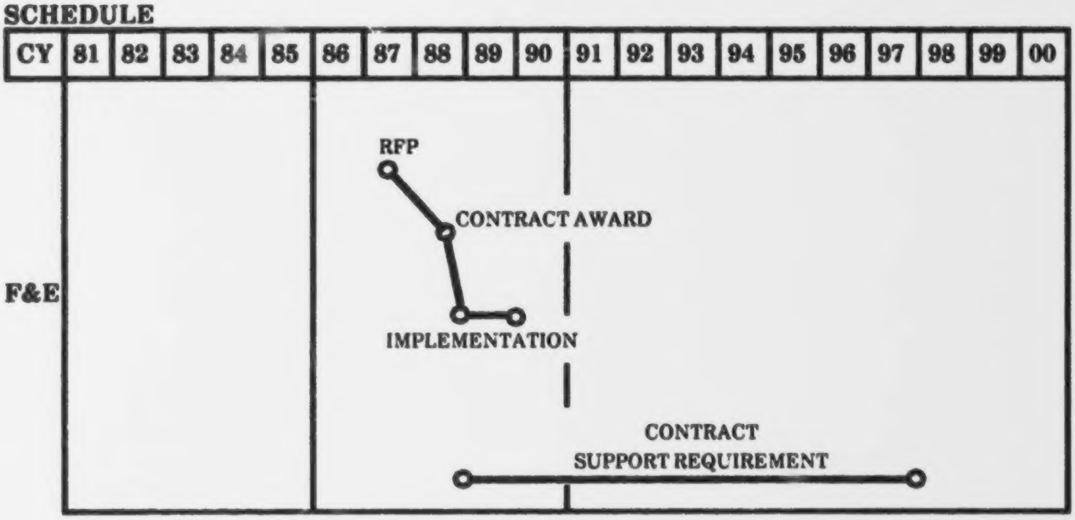
Approach: The approach is to view the general purpose ADP configurations in headquarters, the regions, and centers as a common system of support for all agency elements, and to quantify the current and future demand for such support. Once defined and quantified, the next step is to divest the agency of the operational and technical functions of this support to the commercial arena, devoting the FAA's limited ADP staff resources to better satisfying its programmatic requirements.

The contract created to fill the void generated by this divestiture will procure all government owned computer resources and subsequent upgrades; provide for the design and conversion to link to the administrative telecommunications network; and provide all staffing, hardware, systems software, and off-the-shelf applications software to meet the requirements for general purpose host computer processing for all elements of the agency, region, center, and headquarters in a timely and economical manner.

Products: The uniform and expandable general purpose computer resources, facilities, and technical and operational services necessary to satisfy the current and future programmatic automation needs of the agency in a timely and cost effective manner.

Related Projects/Activities: None.

SCHEDULE



PROJECT 3: Aeronautical Center Lease

Purpose: This project provides for the lease payment to the Oklahoma City Airport Trust (OCAT) for the land and buildings which currently house the Mike Monroney Aeronautical Center and tenant FAA organizational elements.

Approach: The Aeronautical Center is a major organizational complex in Oklahoma City, Oklahoma. It conducts centralized training, aircraft fleet maintenance and modification, central warehousing and supply, aeromedical research, and maintains and administers aircraft and airman (including medical) records. The Aeronautical Center also provides centralized administrative automatic data processing for national programs, provides engineering support, and technical modification and maintenance field guidance for the operation and maintenance of assigned facilities in the National Airspace System.

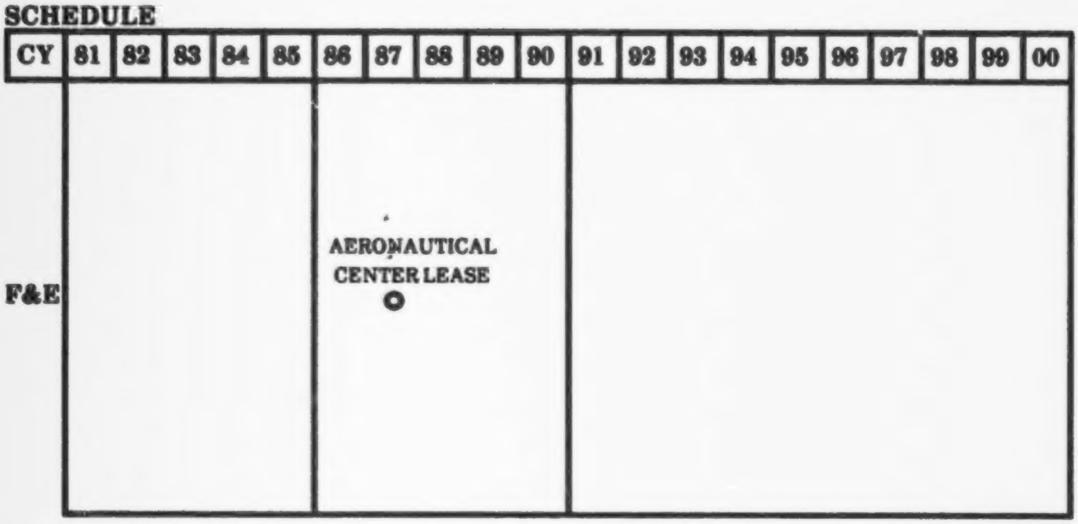
The land and buildings which house the Aeronautical Center, as well as tenant FAA organizational elements, are leased from the Oklahoma City Airport Trust, thereby providing a cost-effective, mid-continent location for the vital functions described above.

Products:

- Mike Monroney Aeronautical Center building lease.

Related Projects/Activities: This program supports ongoing F&E efforts and operations.

SCHEDULE



PROJECT 20: EFAS Expansion

Purpose: This project will provide additional communications channels for coverage at 18,000 feet and above, for the collection and dissemination of pilot reports (PIREP) and en route weather information.

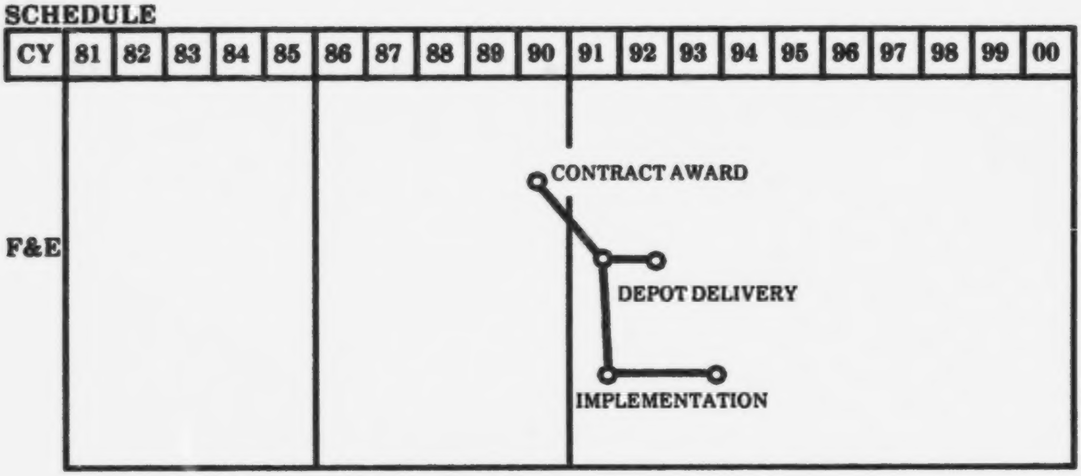
Approach: Establish discrete frequencies in addition to 122 MHz and those provided by the NAS Plan. Discrete frequencies would be protected from adjacent flight watch control station (FWCS) frequencies to reduce frequency overlap problems. Implementation for 20 FSS EFAS or AFSS EFAS facilities will require approximately 42 additional communications outlets, selected in accordance with plans for air-ground communications facility consolidation.

Products: An estimated 42 communications outlets, controlled from FSS EFAS locations, will be established.

Related Projects/Activities:

- Frequency and spectrum engineering will ensure that EFAS frequencies are free of interference.
- Site locations for EFAS equipment will be chosen in conjunction with communications facility consolidations.
- Hardware supporting this project will be procured in conjunction with Air/Ground Communications Modernization.
- FSAS - As FSS consolidation proceeds, service will be provided from 20 AFSSs.

SCHEDULE



PROJECT 30: Air/Ground Communication Radio Frequency Interference (RFI) Elimination

Purpose: This project will provide selected remote communication facilities (RCFs) with modern state-of-the-art equipment, and ancillary equipment to improve operational performance in an increasingly crowded radio frequency spectrum. The existing equipment is technologically obsolete and does not meet minimum performance requirements for the congested radio frequency spectrum environment. The RCF equipment is used for transmitting and receiving analog voice between air traffic personnel and aircraft pilots using the numerous RCFs (formerly identified as RCAG, RTR, and RCO facilities). The RCF RFI solution is required to improve air/ground radio communication service.

The rf spectrum is becoming more crowded as aviation grows and as air/ground radio communication antenna facilities are consolidated. An increasing concentration of air/ground radio communication frequencies in a specific geographic location requires improvements in the communications equipment and system.

These improvements will provide a reduction in intermodulation products, and improved interference reduction. The existing equipment have reached the end of their 20-year life cycle. The design of the existing equipment does not meet the current rf spectrum requirements.

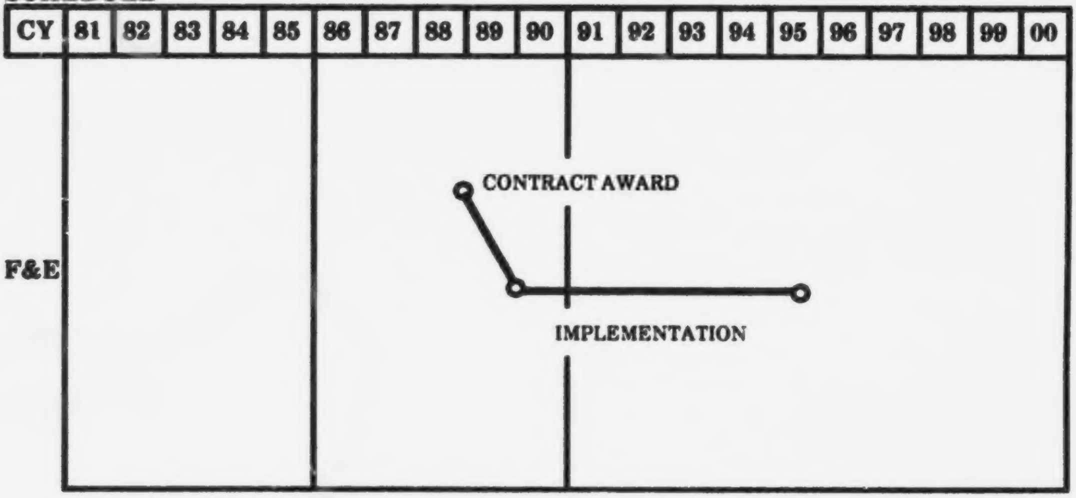
Approach: Procure state-of-the-art equipment to resolve existing RFI problems.

Products: Up to 2000 state-of-the-art receivers may be provided to resolve RFI problems at affected locations.

Ancillary devices such as antenna/multicoupler/cavity/combiner to reduce intermodulation.

Related Projects/Activities: Communication Facility Consolidation, Radio Control Equipment (RCE) and NAS Spectrum Engineering.

SCHEDULE



PROJECT 40: Low Power TACAN Antennas

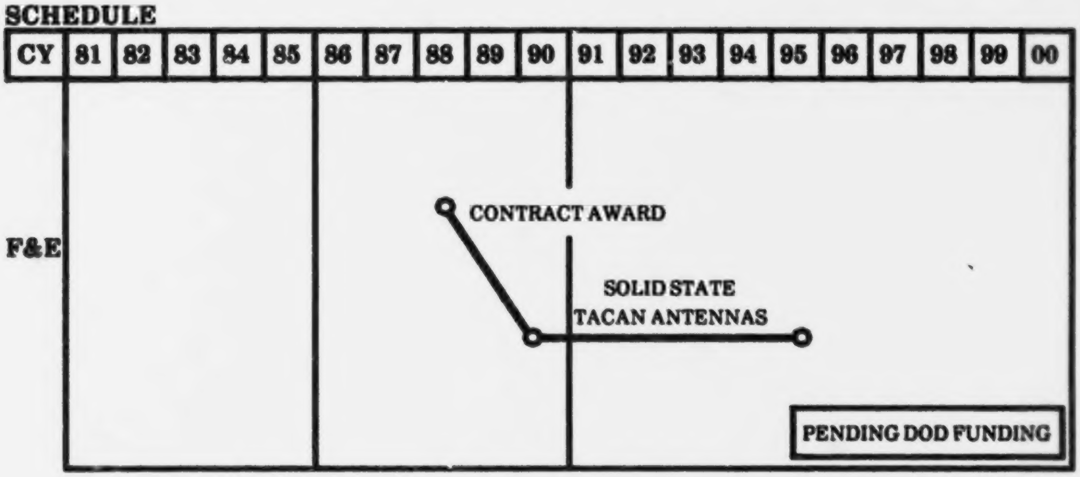
Purpose: The DOD requires TACAN for air navigation throughout the 1990s. The present TACAN antenna consisting of rotating elements is experiencing logistic support problems, which compromise TACAN availability.

Replacement of obsolete antennas with low power TACAN antennas will reduce power requirements from 5,000 watts to 250 watts. This reduction removes the requirement for an engine generator, allows the TACAN to operate on batteries, and provides TACAN service regardless of power line interruptions. In addition, the low power TACAN antenna will be easier to maintain. It has integral monitoring, and an estimated mean time between failures of 10,000 hours.

Approach: FAA and DOD will jointly fund replacement of the existing mechanical rotating TACAN antennas with new low power TACAN antennas. DOD is currently expected to provide funds to acquire 70 solid-state TACAN antennas. Future quantities to be replaced will be based on DOD requirements and the availability of shared funding.

Products: Procurement of up to 497 low power TACAN antennas is anticipated.

Related Projects/Activities: The VORTAC project is related to this activity



PROJECT 50: Sustain Telecommunications Support

Purpose: As a strategic objective, the FAA is committed to reducing dependence on leased telecommunications in order to improve reliability, flexibility, and survivability, as well as to control and reduce costs. The FAA has pursued this objective through: NAS Plan projects that result in major FAA owned telecommunications facilities; the implementation of FAA-owned airport telecommunications; and the acquisition of engineering services and equipment to support leased communications initiatives to improve service and save costs. This project establishes the resources necessary to provide follow-on support for these efforts to further avoid cost.

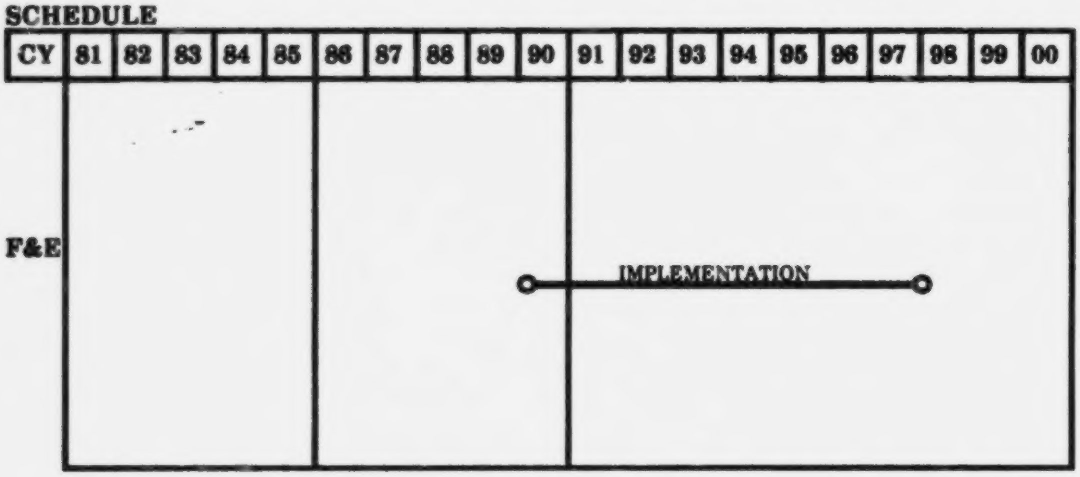
Approach: Agency telecommunications project offices and telecommunications management and operations functions identify specific sustaining telecommunications requirements and support activities. Procurements are initiated as required.

Products:

- Telecommunications Facilities Operation:
  - Software updates and enhancements
  - Hardware updates and enhancements
  - System/component reconfigurations
  - Performance upgrades
- Airport telecommunications:
  - Airport telecommunications facilities
- Leased communications initiatives:
  - Technology improvements
  - FAA ownership of embedded base equipment
  - Centralized facility circuit termination equipment

Related Projects/Activities: Related projects and activities include: RCL; NADIN IA; NADIN II; Airport Telecommunications; Data Multiplexing; all NAS systems and projects requiring telecommunications.

SCHEDULE



PROJECT 60: Computer Based Instruction (CBI) Expansion

Purpose: This project will provide for the expansion/update of the present CBI training capability, and for specialized AAS transition training for operations and maintenance personnel in all Air Traffic and Airways Facilities field locations.

CBI provides prerequisite training, and will provide national airspace system equipment introduction and overview training at airways facilities field locations for NAS systems. Part-task simulation and trouble-shooting training will enhance Academy classroom training for new equipment/ NAS training classes. CBI will continue to support a program of individually prescribed proficiency and other training in the field for Air Traffic, Airways Facilities and Flight Standards personnel.

During 1981-1985 a number of Airways Facilities courses were developed and provided at over 90 field locations. About 50% of the overall AF training requirements were met with this new technology in 1986. Additional high volume technical training will be developed in FY-87 and FY-88, for Airway Facilities, Air Traffic and Flight Standards.

Approach: CBI learning centers will be established at AF sector field offices. Existing equipment will be replaced at AF sector offices, FIFOs, regions, centers, and the Academy to handle existing training programs and new NAS requirements. Learning centers will also be established in all AT and AF field locations where there will be a substantial requirement for high volume AAS transition training, to allow the training to occur at local work sites to the greatest extent possible. This AT and AF transition training will be developed by the AAS system contractor using government furnished equipment integrated with the FAA CBI system. This advanced automation training system (AATS) will be integrated with the FAA's ongoing CBI system to assure maximum administrative and operational efficiency, and software compatibility.

Overall, the new system will decrease dependency on real time telecommunications and mainframe software support. On-line facilities will continue to be used for student management, final testing, evaluation, updates and record keeping. To provide the AF expanded system and improvements, a contract will be awarded in 1988 to expand/upgrade existing CBI systems, and to initiate equipment/ software procurement for AT/AF training requirements associated with the advanced automation training program. Implementation will begin the latter part of 1988 for AAS, and in 1989 for the AF expansion. The initial contract will include options for additional hardware/software, and provisions for execution of these options in 1990 for additional systems to complete the entire required inventory.

Products: In 1989, 350 new terminals with hard disk drives and printers are required for sector field offices; upgrading is needed for existing terminals at airway facilities, and flight inspection field offices, the FAA Academy, Technical Center and Headquarters.

The AAS training program will begin with the delivery of hardware and software as GFE to the AAS contractor in 1988. Prior to AAS implementation, learning stations will be installed at all center, tower and approach control facilities, the Academy and Technical Center. Systems will be provided to region and academy locations for management of all training information and record keeping.

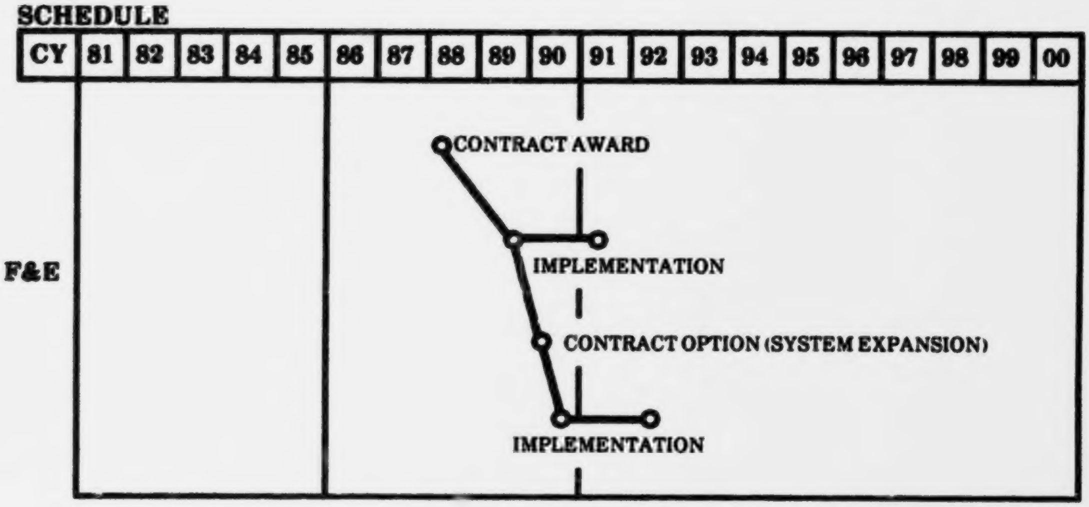
During 1990, Air Traffic terminals procured in 1983 will be upgraded (hard disk technology), and 100 new Aviation Standards terminals will be provided to expand the locally delivered portions of training for Aviation Standards inspection and technical staffs started in 1988, under the auspices of Project SAFE, Safety Activity Functional Evaluation.

In 1991, the CBI terminals existing in the airway facilities and flight inspection locations prior to 1990 will be upgraded with new software and video enhancements.

During 1992, software and other state-of-the-art voice enhancements will be completed on all air traffic CBI terminals.

Related Projects/Activities: Chapter 6 contains the baseline requirements for computer based instruction learning centers (hardware/ software, courseware), where there are concentrations of field personnel.

SCHEDULE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F&E
CONTRACT AWARD
IMPLEMENTATION
CONTRACT OPTION (SYSTEM EXPANSION)
IMPLEMENTATION

PROJECT 61: Fuel Storage Tanks

Purpose: The Hazardous and Solid Waste Amendments of 1984 to the Clean Water and Solid Waste Disposal Act requires that owners (including the Federal Government) of underground petroleum fuel storage tanks shall; notify local (state, county, municipal) governments of such tanks; clean up sites that are leaking and replace tanks; install leak detectors to prevent further environmental pollution.

Fuel tanks in the FAA inventory have a life expectancy of 15 years, and most of them have been in use from 10 to 25 years.

Approach: The power policy directive will be changed to reflect a decreasing need for engine-generator standby power. Leaking tanks will be located by analysis of soil beneath the tank and be replaced or removed. The site will be cleaned up to acceptable standards. Engine generators will be replaced by battery standby power at many locations. Some small gasoline engine generators will be converted to propane fuel with an above ground tank. Double-walled fiber glass tanks with internal leak detectors will be installed at sites where continued use of engine generators is required. RMM compatible fuel leak detectors are required to preclude the possibility of future leaks causing either soil or water contamination.

Products: Leaking fuel tanks will be located and replaced. Either new tanks will be installed or small engine-generators will be converted to propane fuel with above-ground tanks. The affected inventory has been estimated to be 425 sites (15% of tanks over 15 years old). Batteries will also be provided where necessary.

All remaining tanks that are over 15 years old, and are not candidates for battery standby power will be replaced. This should occur at 682 sites.

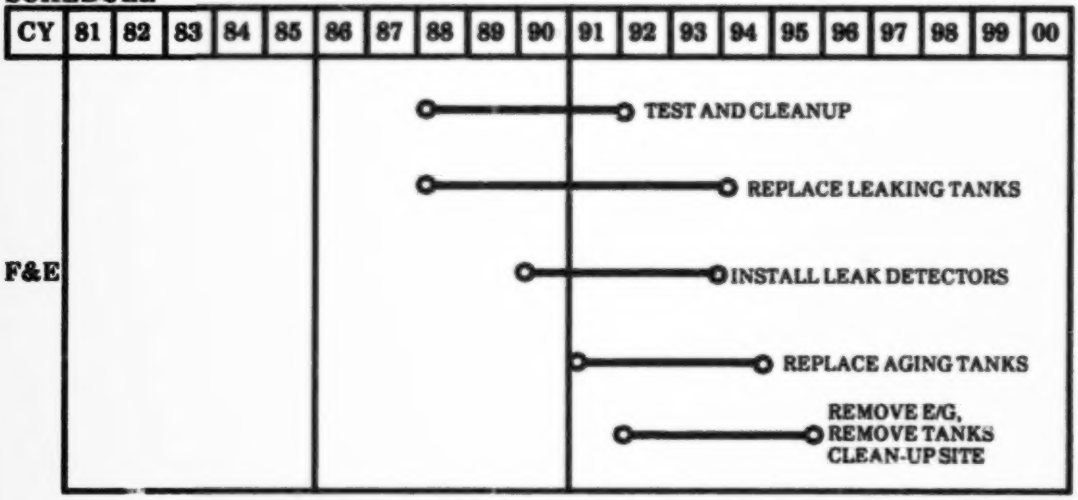
Leak detectors will be installed at sites that are candidates for battery standby power. The affected inventory has been estimated to be 2043 sites.

Leaks may develop at 15% of the sites where fuel tank replacement is deferred. This may occur at an additional 306 sites. These sites will be converted to propane fuel, with an above ground tank to reduce the cost of the program.

Removal of tanks, site clean-up, disposal of tanks, disposal of engine-generators, and associated electrical equipment will be required at 2043 sites after conversion to battery standby power is completed.

Related Projects/Activities: None.

SCHEDULE



PROJECT 70: Terminal Radar Digitizing, Replacement and Establishment

Purpose: Should the FAA continue to require primary surveillance for terminal air traffic control, it will be necessary to ensure high quality service.

This project will digitize or replace ASR 7 and ASR 8 radars to provide sensor data suitable for use in ACFs where the approach control function will be performed. Airport surveillance radar may also be established at additional terminals projected to qualify for service by the year 2000. In addition, in accordance with the Radar Surveillance Network Plan, surveillance coverage will be provided in areas not currently covered by radar. This project also supports relocation of terminal radars as necessary to maintain coverage.

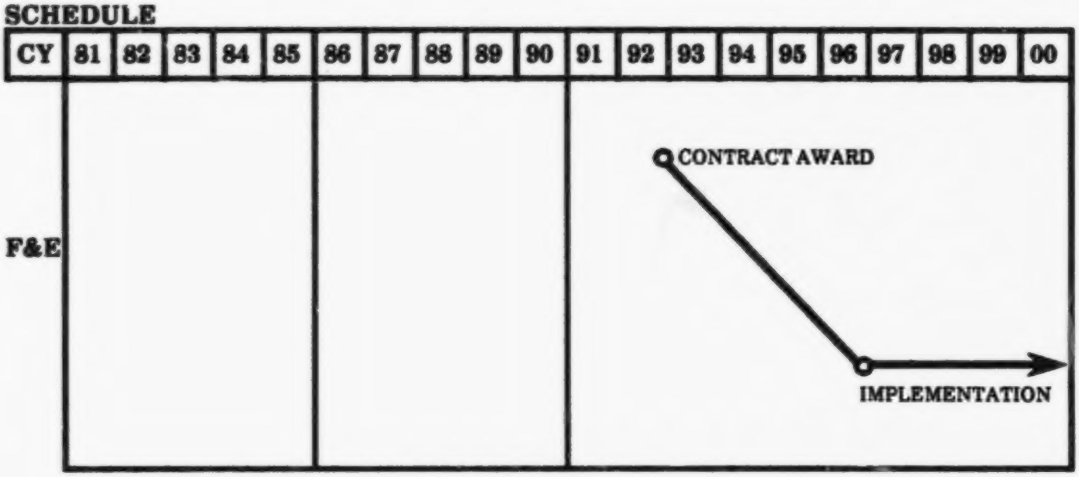
Approach: Ground based radar and satellite equipment alternatives will be considered. Ground basing is currently believed to be the best solution. A specification will be developed for a terminal surveillance radar which includes utilization of post ASR 9 technology. A cost/benefit study will be performed for gap-filler radars to determine if benefits provided by the additional coverage provided by long-range radars offsets the additional cost differential over terminal radar. A contract award is planned in FY-93.

Products: Current plans envision:

- 36 terminal radars to replace ASR 7 radars.
- 65 terminal radars to replace ASR 8 radars.
- 7 terminal radars for newly qualifying terminal facilities.
- 10 terminal radars for gap-filling the existing coverage.
- 22 terminal radars for military facilities to gap-fill the existing radar coverage and replace military terminal radars which serve ACFs.
- 4 terminal radars for support
- 2 mobile terminal radars
- Relocation of terminal radars as required

Related Projects/Activities: ASR 9 terminal radars will form the basis for definition of new terminal radars. If the cost/benefit study shows the gap-filler radars should be long-range, they will be purchased under the long-range radar project. RMMS and NAS Spectrum Engineering are related projects.

SCHEDULE



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PROJECT 71: Sustained National Airspace System Support

Purpose: This project provides for continued long-term investment in routine facility and equipment relocations, restorations, establishments, engineering, and improvement. It sustains, for the 1993-1997 period, actions similar in nature to generalized support obtained prior to 1993, under the auspices of a variety of NAS Plan projects.

Continuing effort is required to relocate, restore, or establish NAS equipment and facilities due to changes in the operating environment, natural catastrophe, or changes in airport/air traffic demand. Examples of required actions include relocating ATCTs if runway construction results in loss of visibility or depth perception, replacing VORs due to floods, providing visual aids to new qualifiers, and upgrading RVR capability as runways become Category II.

Rehabilitation or replacement of physical structures, facility interiors, and plant equipment will also be a continuing effort throughout the century. Such action is needed to overcome normal wear and protect past investment.

Approach: The NAS will be sustained through nationally and regionally sponsored and managed programs and projects. National programs will be undertaken to satisfy geographically dispersed needs, involving the application of policy or standard designs or the acquisition of standard equipments. Regional projects will be undertaken to satisfy relatively low-cost need for modifications, refurbishments, relocations, etc.

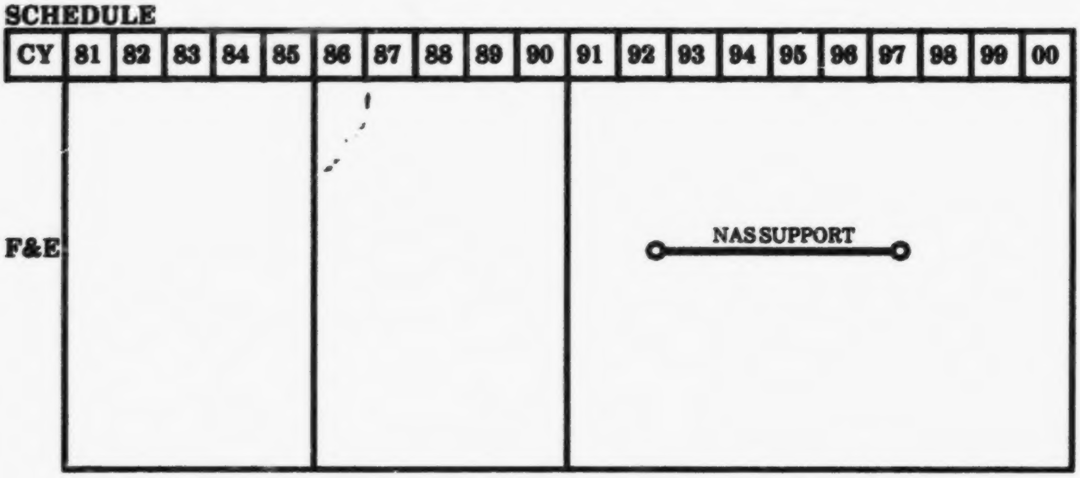
Products: Annually budgeted amounts of facility changes and equipment:

- Relocation
- Restorations
- Establishments for new qualifiers.
- Engineering
- Improvement (rehabilitation, modification, refurbishment, etc.)

Related Projects/Activities: This project sustains continuing efforts in project areas such as:

- ATCT/TRACON Establishment, Replacement and Modernization (2-13)
- VFR/ATCT Closures (2-14)
- Communications Facilities Consolidation (4-02)
- VORTAC (4-03)
- Nondirectional Beacons (4-04)
- Runway Visual Range (4-08)
- Visual Navaids (4-09)
- Approach Lighting System Improvement Program (4-10)
- Power Systems (6-07)
- Unmanned Facilities (6-08)
- ARTCC Plant Modernization (6-09)
- NAS Spectrum Engineering (6-15)
- General Support (6-16)
- System Support Laboratory (6-17)
- General Support Laboratory (6-18)

SCHEDULE



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PROJECT 80: Weather Communications Processor (WCP)/Data Link Enhancements

Purpose: This project develops and implements an enhanced WCP system to provide increased system capacity, and to support additional data link services. The WCP enhancements will support higher transaction rates for serving a greater number of Mode S data link equipped users. Additional weather products will be provided by the WCP enhancements. The additional services that will be provided to Mode S data link users by the WCP enhancements include the delivery of hazardous weather radar graphic products, the filing of pilot reports, the delivery of NOTAM information, and the delivery of aviation route forecasts.

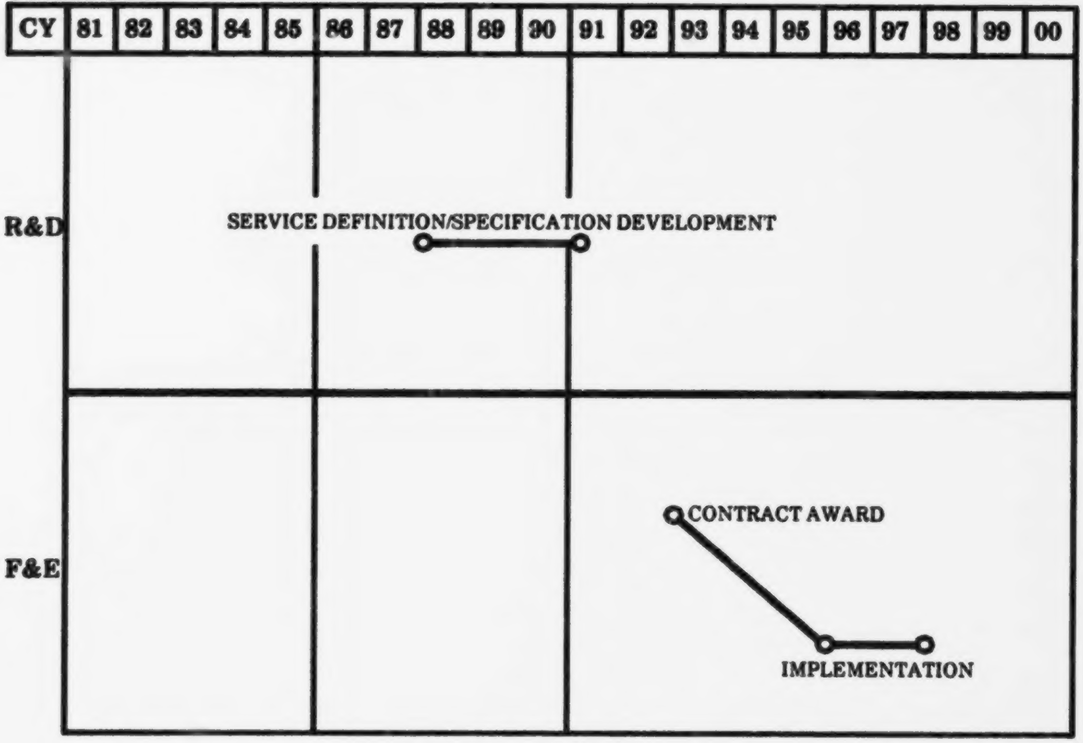
Approach: Data link services will be defined based on results of simulations and flight tests. Functional and performance specifications will be developed. The WCP processing capacity will be enhanced through either augmentation of the initial WCP system processing hardware or by replacement of the initial WCP processing hardware with a higher capacity system. The existing WCP software will be rehosted, if required, with significant augmentation for the new data link applications.

Products: Hardware and software enhancements for 24 WCP systems, 22 at operational ARTCCs/ACFs, 1 at FAATC, and 1 at FAA Academy.

Related Projects/Activities:

- CWP – The CWP will interface with the WCP and will provide hazardous weather graphical data to the WCP. The WCP will provide CWP with pilot reports filed by Mode S data link equipped users.
- WMSCR – The WMSCR will provide NOTAMs and other weather products to the WCP for delivery to Mode S data link users.
- NADIN II – NADIN II will provide the telecommunications path between the WMSCR and the WCP.
- LCN – The LCN will provide the telecommunications path between the CWP and the WCP and between the NADIN II packet switch and the WCP.
- Mode S – Data link applications will use Mode S to transmit messages between aircraft and ground.

SCHEDULE



PROJECT 81: Additional ASDE Establishment

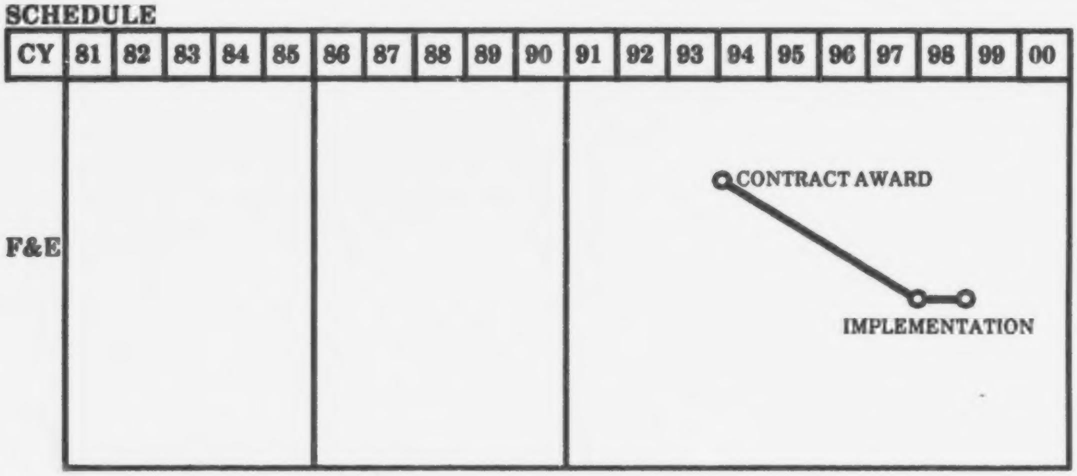
Purpose: This project will provide surveillance of aircraft and airport service vehicles on the airport surface at newly qualifying locations. At high-activity airports, radar monitoring of airport surface operations (ground movements of aircraft and other supporting vehicles) is required to maintain aircraft separation, and provide an effective and expeditious means of directing and moving surface traffic. This is especially important during periods of low visibility, such as rain, fog, and night operations.

Approach: A new specification will be developed for surface surveillance radar. Candidate locations must meet established criteria which is based on airport activity and weather. A contract for required quantities is expected in 1993. The ASDE antenna may be located on top of the airport traffic control tower (ATCT) which may require some minor structural modifications. New installations may require structural modifications to the existing ATCT, or possibly a separate remote tower.

Products: Deliveries are planned to begin in 1997, with the last system delivery in 1998. Seven system establishments are currently projected.

Related Projects/Activities: ASDEs will be remote maintenance monitored. Frequency and spectrum engineering is involved with the ASDE implementation. The Airport Surface Detection Equipment (ASDE 3) radar project provides similar equipment in an earlier time frame.

SCHEDULE



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PROJECT 90: Runway Visual Range (RVR) Replacement and Establishment.

Purpose: This project will install New Generation RVRs and satisfy the need for continued replacement of the older, existing RVR systems. Specifically, the modernization of older RVR systems will provide for the previously unbudgeted replacement of Tasker 500 systems and the establishment of new RVR installations.

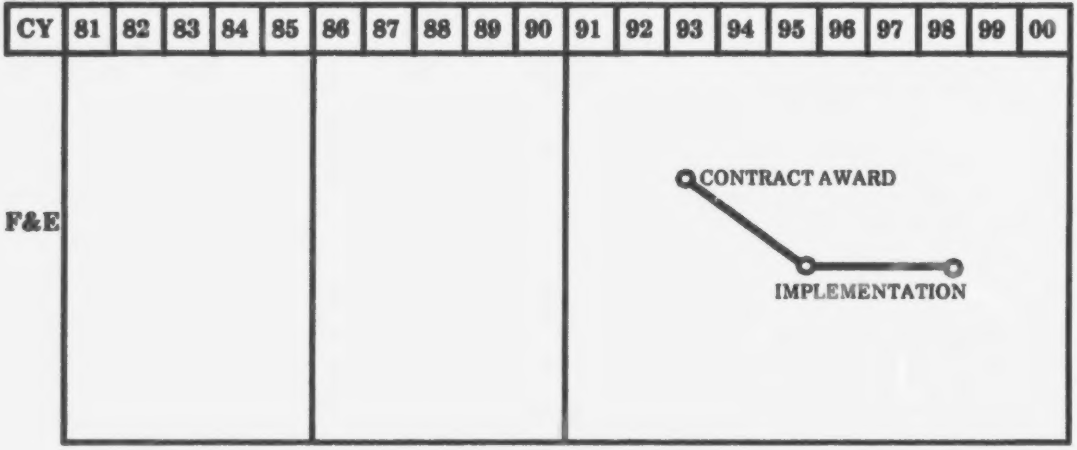
Approach: Provide equipment through a follow-on multi-year procurement program to complete replacement of old Tasker 500 generation RVRs.

Products:

- Replace Tasker 500 RVRs with 178 New Generation RVRs
- Establish 178 new locations

Related Projects/Activities: Microwave Landing System is a related project. APS No. 1 criteria must be met for all CAT I establishment requirements. All Category II/III RVR requirements in support of MLS installations will be funded through the MLS program budget.

SCHEDULE



PROJECT 91: ATCBI Replacement and Establishment

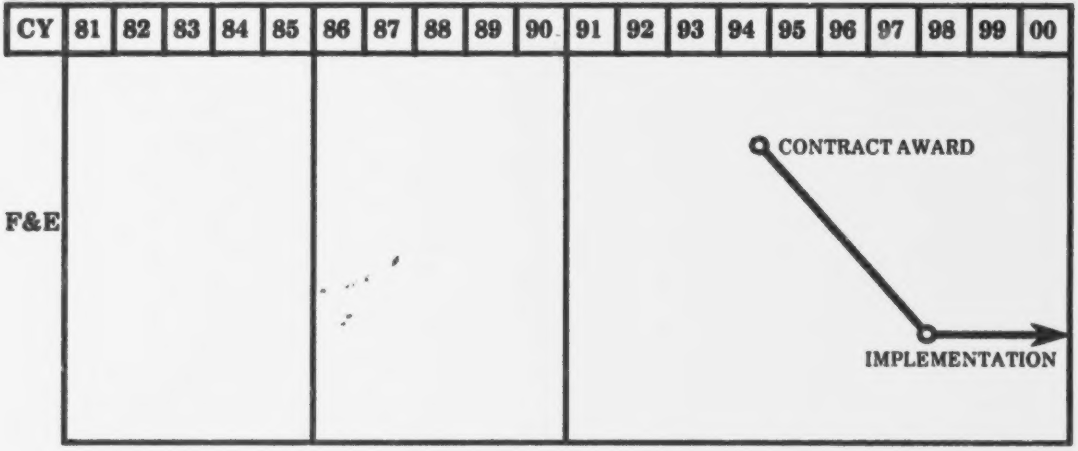
Purpose: Surveillance of aircraft for air traffic control will be required well into the next century. This project will replace aging and obsolete ATCBI equipment with satellites, Mode S units, or ATCRBS units with monopulse capability, upgradeable to full Mode S performance. This project will also establish surveillance capability at newly qualifying airports.

Approach: Should ground-based surveillance be the preferred option, additional Mode S units, or ATCRBS units with monopulse will be procured to replace existing ATCBI equipment and to support new establishments.

Products: 199 Operational Mode S units/ATCRBS units with monopulse.

Related Projects/Activities: Mode S, RMMS, and NAS Spectrum Engineering are related projects.

SCHEDULE



PROJECT 92: Long-Range Radar Replacement and Networking

Purpose: Should the FAA continue to require primary surveillance for en route air traffic control, it will be necessary to provide the service either by ground-based or satellite equipment. If ground-based equipment continues to be the only feasible mode, we will need to replace the obsolete LRRs in the network. This project describes the ground-based replacement system.

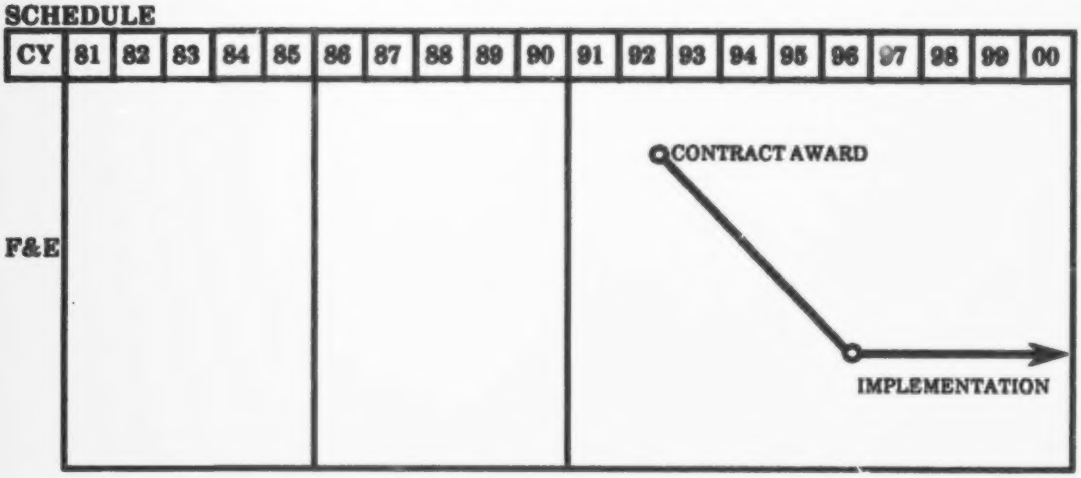
Approach: The Radar Surveillance Network Plan which included Mode S for secondary radar surveillance coverage and data link communications coverage identified a total of 308 existing primary radars and 21 beacon-only facilities. To meet current and future coverage requirements and after analysis of problem areas, relocations, deletions, and establishments, the study indicated a requirement for a total of 360 primary radars and 32 beacon-only facilities. Approximately 54 new solid-state long-range radars are required to replace tube-type radars by the year 2000.

Products:

- Fifty-four (54) solid-state long-range surveillance radars for operational facilities and two (2) for support and relocations, as necessary.
- Relocations as necessary

Related Projects/Activities: This project will require telecommunications service from the NICS. Projects providing that service include RML Replacement and Expansion and Data Multiplexing. RMMS and NAS Spectrum Engineering are related projects.

SCHEDULE



GLOSSARY OF ACRONYMS

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GLOSSARY OF ACRONYMS

AAS	advanced automation system
AATS	Advanced Automation Training System
AC	advisory circular
ACCC	area control computer complex
ACF	area control facility
ADAS	AWOS data acquisition system
ADP	Automated Data Processing
ADS	automatic dependent surveillance
A&E	architectural and engineering
AERA	automated en route air traffic control
AF	Airway Facilities
AFSS	automated flight service station
AFTN	aeronautical fixed telecommunications network
A/G	air-to-ground
agl	above ground level
AIP	Airport Improvement Program
AIRMET	airmen's meteorological information
ALSF	approach light system with sequenced flashing lights
ALSIP	approach lighting system improvement program
AOCI	Airport Operators Council International
APS	Airway Planning Standard
ARF	airport reservation function
ARINC	Aeronautical Radio, Incorporated
ARSR	air route surveillance radar
ARTCC	air route traffic control center
ARTS	automated radar terminal system
ASDE	airport surface detection equipment
ASOS	automated surface observing system
ASP	Arrival Sequencing Program
ASR	airport surveillance radar
AT	Air Traffic
AT&T	American Telephone and Telegraph
ATC	air traffic control
ATCBI	air traffic control beacon interrogator
ATCRBS	air traffic control radar beacon system
ATCT	airport traffic control tower
ATIS	automatic terminal information service
AUTODIN	auomated digital network
AUTOVON	automatic voice network
AVS	aviation standards
AWANS	aviation weather and NOTAM system
AWOS	automated weather observing system
AWP	aviation weather processor
BDIS	automatic data interchange system, service B
bps	bits per second
BRITE	bright radar indicator tower equipment
BUEC	backup emergency communications
CA	conflict alert
CA/MSAW	conflict alert/minimum safe altitude warning

CARF	central altitude reservation function
CBI	computer based instruction
CCD	consolidated cab display
CCP	contingency command post
CD	common digitizer
CDC	computer display channel
CDT	controlled departure times
CERAP	combined center radar approach control
CFCC	central flow control computer
CFCF	central flow control function
CFDPS	compact flight data processing system
CFWP	central flow weather processor
CFWSU	central flow weather service unit
CNS	consolidated NOTAM system
COMLO	compass locator
COMSEC	communications security
CONUS	continental, contiguous, or conterminous United States
CRA	conflict resolution advisory
crt	cathode ray tube
CWP	central weather processor
CWSU	center weather service unit
DARC	direct access radar channel
dc	direct current
DCC	display channel complex
DES	data encryption standard
DF	direction finder
DME	distance measuring equipment
DME/P	precision distance measuring equipment
DOD	Department of Defense
DOT	Department of Transportation
DSB	double sideband
DSP	departure sequencing program
DUAT	direct user access terminal
DVOR	Doppler very high frequency omnidirectional range
EARTS	en route automated radar tracking system
E-DARC	enhanced direct access radar channel
EDCT	estimated departure clearance time
EFAS	en route flight advisory service
ELOD	en route sector load
EMC	electromagnetic compatibility
EOF	emergency operations facility
EPA	Environmental Protection Agency
ERL	Environmental Research Laboratories
ERM	en route metering
ESMMC	enhanced SMMC
ESP	en route spacing program
ETG	enhanced target generator
FAA	Federal Aviation Administration
FAATC	FAA Technical Center
FDEP	flight data entry and printout
FDIO	flight data input/output
FDPS	flight data processing system
F&E	facilities and equipment
F,E&D	facilities, engineering, and development

FIFO	flight inspection field office
FIR	flight information region
FM	frequency modulation
FPS	military primary radar
FSAS	flight service automation system
FSDPS	flight service data processing system
FSP	flight strip printer
FSS	flight service station
FSTN	federal secure telephone network
FY	fiscal year
GAO	Government Accounting Office
GFE	government-furnished equipment
GNAS	general NAS
GOES	geostationary operational environmental satellite
GPO/GPI	general purpose output/general purpose input
GPS	global positioning system
GSA	General Services Administration
GSL	general support laboratory
H	homing radio beacon
HEMP	high altitude electromagnetic pulse
HF	high frequency
HIWAS	hazardous in-flight weather advisory service
HUD	head-up display
HVAC	heating, ventilating, and air conditioning
IBM	International Business Machines
ICAO	International Civil Aviation Organization
ICSS	integrated communications switching system
IFCN	interfacility flow control network
IFM	integrated flow management
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
IMCS	interim MCS
ISSS	initial sector suite subsystem
IVRS	interim voice response system
JAWS	joint airport weather studies
JSS	joint surveillance system
kHz	kilohertz
kW	kilowatt
kWh	kilowatt hour
KDP	key decision point
LCN	Local Communications Network
LLWAS	low level wind shear alert system
LORAN	Long Range Navigation
LRR	long range radar
LRU	line replaceable unit
MALSR	medium-intensity approach lighting system with runway alignment indicator lights
MAR	minimally attended radar
MCC	maintenance control center
MCI	Mode C intruder
MCS	monitoring/control software

MDT	maintenance data terminal
MED	manual entry device
MHz	megahertz
MLS	microwave landing system
MMS	maintenance management system
Mode C	altitude reporting mode of secondary radar
Mode S	discrete addressable secondary radar system with data link
modem	modulator-demodulator
MOS	metal-oxide semiconductor
MPS	maintenance processor subsystem
MSAW	minimum safe altitude warning
msl	mean sea level
MTBF	mean time between failures
NADIN	national airspace data interchange network
NAILS	national airspace integrated logistics support
NAR	National Airspace Review
NARACS	national radio communications system
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NASNET	national airspace system network
NASP	National Airport System Plan
NATCOM	National Communications Center, Kansas City, Missouri
navaid	navigational aid
NAWP	National Aviation Weather Processor
NCC	Network Control Center
NCIU	NEXRAD communications interface unit
NDB	nondirectional beacon
NEOF	national emergency operations facilities
NEXRAD	next generation weather radar
NICS	NAS interfacility communications system
NMC	National Meteorological Center
NMCE	network monitoring and control equipment
NOAA	National Oceanic and Atmospheric Administration
NOTAM	notice to airmen
NPIAS	National Plan of Integrated Airport Systems
NSSF	NAS simulation support facility
NTIA	National Telecommunications Information Agency
NTSB	National Transportation Safety Board
NWS	National Weather Service
ODALS	omnidirectional approach lighting system
ODAPS	oceanic display and planning system
OFDPS	offshore flight data processing system
OMB	Office of Management and Budget
ORD	operational readiness demonstration
OSHA	Occupational Safety and Health Administration
OTA	Office of Technology Assessment
PAPI	precision approach path indicator
PATWAS	pilots automatic telephone weather answering service
PCS	power conditioning system
PIREP	pilot report
ppi	plan position indicator

prf	pulse repetition frequency
PROFS	program for regional observing and forecasting services
PUPS	Principal User Processors
PVD	plan view display
RADS	radar alphanumeric display system
RCAG	remote center air/ground communications facility
RCCC	regional communications control center
RCE	radio control equipment
RCF	remote communications facility
RCL	radio communications link
RCO	remote communications outlet
R&D	research and development
R, E&D	Research, Engineering and Development
REIL	runway-end identification lights
RF	radio frequency
RFI	Radio Frequency Interference
RFP	request for proposal
RML	radar microwave link
RMM	remote maintenance monitoring
RMMS	remote maintenance monitoring system
RMS	remote monitoring subsystem
RMSC	RMS concentrators
RNAV	area navigation
RPG	radar products generator
RRWDS	radar remote weather display system
RTR	remote transmitter/receiver
RVR	runway visual range
RVV	runway visibility value
SAR	system analysis recorder
SEI	system engineering and integration
SET	system embedded training
SIAP	standard instrument approach procedure
SIGMET	significant meteorological information
SMMC	system maintenance monitor console
SSALF	simplified short approach lighting system with sequenced flashing lights
SSALR	simplified short approach lighting system with runway alignment indicator lights
SSB	single sideband
SSF	system support facility
SSL	system support laboratory
SSR	secondary surveillance radar
STEP	service test and evaluation program
STOL	short take off and landing
TAA	terminal advanced automation
TACAN	tactical air navigation
TACS	technical activities committee
TCAS	traffic alert and collision avoidance system
TCCC	tower control computer complex
TCS	tower communications system
TDWR	terminal Doppler weather radar
T&E	test and evaluation
TELCO	telephone company
TML	television microwave link
TMP	Traffic Management Processor

TMS	traffic management system
TMU	traffic management unit
TPX	military beacon system
TRACAB	terminal radar approach control in the tower cab
TRACON	terminal radar approach control
TSC	DOT Transportation System Center
TSSF	terminal system support facility
TV	television
TWEB	transcribed weather broadcast
UHF	ultra high frequency
UPS	uninterruptible power system
USAF	United States Air Force
VASI	visual approach slope indicator
VFR	visual flight rules
VHF	very high frequency
VLF	very low frequency
VOR	VHF omnidirectional range
VORTAC	VOR co-located with TACAN
VOT	VHF omnidirectional range test
VTOL	veritical take off and landing
VRS	voice response system
VSCS	voice switching and control system
WCP	weather communications processor
WMSC	weather message switching center
WMSCR	WMSC replacement
WSR	weather service radar
Wx	weather
9020	IBM computer system model number

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